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E. H. Embley Memorial Lecture.[1]

THE EVOLUTION OF ANÆSTHESIA.

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BEFORE introducing the subject of this paper, I should like to express to the Trustees of the Embley Memorial Fund my most sincere thanks for the great honour which they have conferred on me in selecting me to deliver the third E. H. Embley Memorial Lecture. I feel deeply the responsibility of undertaking this duty, and, considering those who have preceded me, the task is indeed difficult. Although I knew much of Embley's researches and teaching, I had read few of his writings, but now I have been able to obtain all his original papers, with one exception. The reading of these occupied many hours and was most fascinating and enlightening.

A suitable subject for this lecture seemed to be the Evolution of Anæsthesia. In this way it may be shown how Embley's inquiring mind and scientific accuracy assisted in the change from empiricism to the scientific anæsthesia of today, and how they may be of use in predicting the methods by which anæsthesia may advance in the future.

From the earliest times endeavours have been made to provide relief from pain, and especially that of surgical operations. In the pre-anæsthetic era few methods were satisfactory, so the patient was usually strapped down and held by strong assistants. The patient felt the entire operation

[1] Read at a meeting of the Victorian Branch of the British Medical Association on November 17, 1938.

unless he fainted, and death from shock was not infrequent. Little is to be found in the literature about the intense suffering involved. Whether this was due to the callousness of the surgeons, whether it was to keep the knowledge from prospective patients, or whether the scenes in the theatre were too horrifying to be recorded, is difficult to decide. Something, however, can be gathered here and there, as the following quotations will show. Celsus gives as one of the requirements of a surgeon "An intrepid mind void of all tenderness and pity, and entirely deaf to the shrieks and outcries of the suffering patient". Samuel Cooper wrote as late as 1840:

> The patient should not be informed of the necessity of his submitting to an operation long before the period of its performance. The shorter the interval, between the communication of the painful intelligence to him and the performance of the indispensable measure, the better: because his mind brooding on the expected suffering too frequently causes an aggravation of the disease and a most unfavourable derangement of the general health. As highly sensitive hysterical and nervous subjects not only frequently have violent constitutional disturbances after operation, but sometimes die very suddenly, immediately or shortly after their completion, we should avoid, if possible, operating on such individuals; or, if an operation must be done on them, we should apprise their friends of the uncertainty of the result, and administer a cordial with a dose of laudanum a little before the operation commences.

The following quotation is from a letter written by Professor George Wilson to his friend and colleague, J. Y. Simpson, in 1856, recounting an amputation of the leg which he had undergone in 1842.

> The operation was a more tedious one than some which involve much greater mutilation. It necessitated cruel cutting through inflamed and morbidly sensitive parts, and could not be despatched by a few strokes of the knife. I do not suppose that it was more painful than the majority of severe surgical operations are, but I am not, I believe, mistaken in thinking that it was not less painful, and this is all that I wish to contend for. . . .
>
> Of the agony it occasioned I will say nothing. Suffering so great as I underwent cannot be expressed in words, and thus fortunately cannot be recalled. The particular pangs are now forgotten; but the black whirlwind of emotion, the horror of great darkness, and the sense of desertion by God and man, bordering close upon despair, which swept through my mind and overwhelmed my heart I can never forget, however gladly I would do so. . . .
>
> During the operation, in spite of the pain it occasioned, my senses were preternaturally acute, as I have been told they generally are in patients in such circumstances. I watched all that the surgeon did with a fascinated intensity. I can recall with unwelcome vividness the spreading out of the instruments; the twisting of the tourniquet; the first incision; the fingering of the sawed bone; the sponge pressed on the flap; the tying of the blood-vessels; the stitching of the skin and the bloody dismembered limb lying on the floor.
>
> These are not pleasant remembrances. For a long time they haunted me, and even now they are easily resuscitated; and though they cannot bring back the suffering attending the events which gave them a place in my memory, they can occasion a suffering of their own, and be the cause of a disquiet which favours neither mental nor bodily health. From memories of this kind, these subjects of operations who receive chloroform are of course free; and could I even *now*, by some Lethean draught, erase the remembrances I speak of, I would drink it, for they are easily brought back, and they are never welcome.

One of the earliest forms of anæsthesia was practised by the ancient Assyrians, who used compression of the carotid arteries to render the operation of circumcision painless. Hua Tu, the father of Chinese surgery, is still worshipped in many temples throughout China, as the god of surgery. He was born about A.D. 190 and was a

FIGURE I.
Operation in pre-anæsthetic era. (After Hildanus, from "Acupressure", by J. Y. Simpson.)

scholar and a surgeon. He used very few drugs and only used acupuncture in a few selected cases. In abdominal conditions, when these procedures were ineffectual, he performed laparotomy, operated

FIGURE II.
Hua Tu. (Taken from *The Bloodless Phlebotomist*, Volume II, Number 2.)

upon the stomach, removed lengths of diseased intestine and sutured the healthy portions. His patients were given a secret draught which caused unconsciousness during the operation.

Medicinal herbs, such as hyoscyamus, mandragora, opium and hemp were undoubtedly used to lessen or remove the pain of operation; illustrations of this are found in some fifteenth century books on surgery. Certain of these narcotics were given by the mouth and they included many quaint prescriptions, one of which reads as follows:

> Take the oil pressed out of fresh herrings, a pint, a boar's gall, juices of henbane, hemlock, aifel (that is little house leek), lettuce and wild cat-mint. Each six ounces. Mix together and boil them well, and put them into a glass vessel well stopt. Then take three spoonfulls of the above and put into a quart of warm ale and let the person who is to undergo any operation sit before a large fire, and drink of this by an ounce at a time, till he falls asleep, which sleep will continue during the space of three or four hours; and all the time he will be insensible to any thing done to him.

Other drugs were given by inhalation from the "narcotic sponges". A fresh sponge was soaked in extracts of the medicaments and then dried. When required for anæsthetic purposes it was dipped in

FIGURE III.
Operation under anæsthetic, sixteenth century. (After Brunschvig: "*De Chirurgica*".)

warm water and held to the nostrils of the patient, who, according to repute, by inhaling the vapours, fell into a deep sleep. From the ninth to the fifteenth century there are references to them by German, French, Italian and Spanish surgeons. In the thirteenth century, Hugo de Lucca employed mandragora as a general anæsthetic, and his method was described by his son Theodoric. Even as late as 1847, Dauriol recorded five cases in which he had successfully employed this means of bringing about insensibility during operations. But it has not been possible to reproduce these happy results in modern times. In 1927 Marguerite Louise Baur experimented with narcotic sponges in Professor Wiki's laboratory, in Geneva. Small narcotic sponges made according to the old formulæ were placed under a bell jar in which there was a guinea-pig; even after nine hours no narcotic effect had been produced, although the sponge had been subjected to heating to cause further evaporation.

In 1789 Benjamin Bell mentions an instrument, proposed by Mr. James Moore, of London, which was a screw-clamp, like a tourniquet, which was to

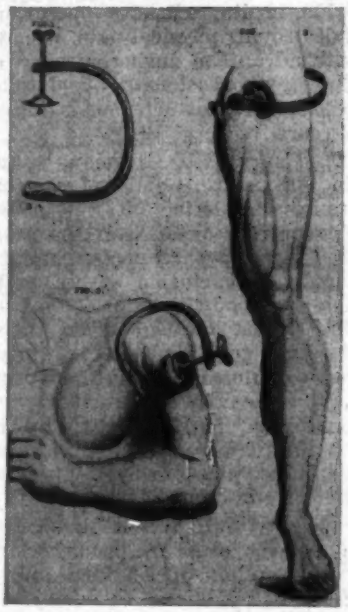


FIGURE IV.
Anæsthetic clamp invented by Mr. James Moore, of London. From "A System of Surgery", by Benjamin Bell.

compress the principal nerves so completely as to render the parts beneath altogether insensible. However, it was found that the pain of the instrument itself was too great to be borne.

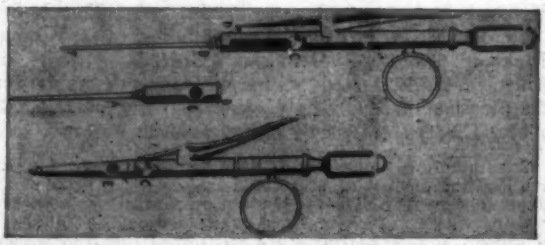


FIGURE V.
Early hypodermic syringe, 1861. (Taken from *The Dublin Quarterly Journal of Medical Science*, 1861.)

Anæsthesia, as now known, owes its origin to the discovery of hydrogen by Cavendish (1766), of nitrogen by Rutherford (1772) and of oxygen and nitrous oxide by Priestly (1774). The idea of employing these gases by inhalation for the

treatment of disease was taken up by the medical profession. In 1798 Dr. Beddoes opened a "Pneumatic Institute" at Clifton, where he treated pulmonary tuberculosis and other diseases by inhalation of gases and vapours. Humphry Davy was his assistant, and studied the action of the various gases both on patients and on himself. One day, while suffering from the pain of cutting a wisdom tooth, he inhaled nitrous oxide on three occasions and found that he was temporarily relieved of pain. In 1860 he published a book in which he stated: "As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place." This suggestion was not acted upon in surgery for another 42 years.

In 1824, Henry Hill Hickman, a surgeon, of Ludlow, in Shropshire, published a pamphlet, its title beginning "A letter on Suspended Animation. . . .", reporting experiments on animals. He had rendered them unconscious by partial asphyxiation produced by exclusion of air, and later by inhalation of carbon dioxide or nitrous oxide. During this period he had made incisions and amputated ears and limbs without pain. He endeavoured to interest the medical profession in England and France in the possibility of preventing pain during surgical operations by this means. His work was treated with scepticism and scorn, and he died in 1829 without having been allowed to demonstrate his work to others.

During the first half of the nineteenth century, there was an odd class of people who travelled about the country, both in England and the United States, lecturing in public on chemistry. During the course of a lecture it was the custom to invite persons from the audience upon the stage to inhale nitrous oxide or ether vapour in order to produce exhilaration, excitement and mirth-provoking antics. Owing to the pleasant sensations produced by these inhalations, it became a popular entertainment in country districts of America for young people to have parties for this purpose; these were termed "ether frolics". To these ether frolics is owed the discovery of surgical anæsthesia. On March 30, 1842, Dr. Crawford Williamson Long, of Jefferson, Jackson County, Georgia, United States of America, administered ether to James Venable for the purpose of removing a cyst from the back of the neck. His reason for this was given as follows:

> On numerous occasions I have inhaled ether for its exhilarating properties, and would frequently, at some short time subsequently discover bruises or painful spots on my person, which I had received while under the influence of ether. . . . These facts are mentioned that the reason may be apparent why I was induced to make an experiment in etherisation.

Venable was chosen as he wished a painless operation and "was fond of and accustomed to inhale ether". The original fee for the operation was twenty dollars, but as an inducement to the young man to submit to the operation, a nominal fee of two dollars was made. Although Long used ether a number of times for operations, he did not make any endeavour to communicate his results to others. This may be in part due to the fact that Jefferson was a remote township, 140 miles from the nearest railway.

No further advances took place until 1844, when Horace Wells, a dentist of Hartford, Connecticut, attended a lecture by Dr. Gardner Colton on nitrous oxide and other gases. Wells noticed that one of the audience, Mr. Cooley, while under the influence of laughing gas, had struck and injured his leg against a bench without suffering pain. So he asked Colton to administer it to him while Dr. John M. Riggs extracted an aching molar tooth. The extraction was performed quite painlessly. Wells then began to use the method in his practice. His enthusiasm encouraged him to demonstrate the method in a major surgical operation at the Massachusetts General Hospital, Boston. The demonstration was a complete fiasco, and Wells was hissed out of the theatre by students and nearly mobbed as an impostor. By this failure nitrous oxide was discredited and the method abandoned. Wells was so chagrined that he became insane and committed suicide in 1848. It was revived by Colton in 1863, and, by 1867, he was able to give the records of 20,000 successful cases in dentistry. It was demonstrated by Dr. Evans, of Paris, who used Colton's apparatus, at the Royal Dental Hospital of London in 1868. A committee of English dentists was formed to investigate the method; their report was so favourable that nitrous oxide became established as a safe and efficient anæsthetic for short operations.

Hypnotism of some kind had been practised for centuries by the Egyptians, Persians and Hindus. In 1661, Greatrakes, "the Irish Stroker", produced "magnetic sleep" by stroking and making passes over the patient's face. In 1766, Mesmer, a Swiss, evolved his theory of "animal magnetism". He undertook to cure disease by it and founded a hospital in Paris. In 1785 a Royal Commission inquired into his methods and decided that they were unworthy of belief. Braid, of Manchester, tried his "neurhypnotic trance" to produce surgical anæsthesia. Esdaile, in India, employed mesmerism extensively as a means of producing insensibility to pain during surgical operations. He wrote several books on the subject, one of which was "Mesmerism in India and its Practical Application in Surgery and Medicine". In this he stated that from May, 1845, to January, 1846, he had performed no less than seventy-three painless operations under mesmerism.

The year 1846 will always be memorable as the beginning of the true anæsthetic era, when it was discovered that complete surgical anæsthesia could be produced by the inhalation of ether vapour. William T. G. Morton, who was a pupil and later partner of Wells, had been a witness of Wells's failure to demonstrate nitrous oxide anæsthesia. He continued the search for some means of eliminating pain and consulted Dr. C. T. Jackson, a chemist, about the manufacture of nitrous oxide. Jackson

suggested that he should try sulphuric ether instead, as it was easier to obtain. Morton obtained some chemically pure ether and began to experiment. His first attempt was on two students, Spear and Leavitt, but the results were unsatisfactory. He next tried dogs and finally he himself inhaled the vapour from a handkerchief after looking at his watch. He soon lost consciousness and describes his recovery as follows:

> As I recovered I felt a numbness in my limbs, and a sensation like a nightmare. I thought for a moment I should die in this state, but at length I felt a slight tingling of the blood in the end of my third finger, and made an effort to press it with my thumb, but without success. At the second effort I touched it, but there seemed to be no sensation. I gradually raised my arm and pinched my thigh, but could see that the sensation was imperfect. I attempted to rise from my chair but fell back, and looked immediately at my watch and found I had been insensible about seven or eight minutes.

A few days later a patient, Eben Frost, asked Morton to mesmerize him and extract a tooth, as he feared the pain, and as mesmerism was then the vogue. Morton persuaded him that he knew a better method, gave him ether to inhale and extracted the tooth painlessly. Morton reported the results to Dr. Warren, a well-known surgeon, and requested him to allow it to be tried for a surgical operation. This was done on September 30, 1846, on Gilbert Abbott, at the Massachusetts General Hospital. It was so successful that the experiment was repeated and the news rapidly spread over the world.

Perhaps the most interesting period in the history of anæsthesia is that of its introduction into England. The medical journals of 1847 are most fascinating to read in the light of our present knowledge. The first reference that I have been able to find is in *The Lancet*, of December 26, 1846, where there is the following short note:

> Dr. Bigelow, of Boston, United States, has recently read a paper before one of the medical societies on a process of procuring insensibility to pain during surgical operations. Teeth in large numbers have been extracted, and even limbs amputated, without pain. Such a discovery, if it stands the test of examination, will be an invaluable boon. The means used is believed to be the inhalation of sulphuric ether for two or three minutes, which, it is stated, produces insensibility for an equal length of time.

However, it was in the following year that the subject was properly introduced. In *The Lancet*, of January 2, 1847, there is a letter from Dr. Boott:

> I beg to call your attention to the report of an anodyne process, by means of which surgical operations have been performed without pain. I think it would be interesting to the profession if published in *The Lancet*. I also send a letter from Dr. Bigelow, bearing date more than three weeks after the report drawn up by his son. I wish to add, that Dr. Bigelow is one of the first physicians of Boston, and a man of great accomplishment.

This was accompanied by Dr. Bigelow's letter and also one from Liston, dated December 21, 1846, recording his first operations under ether on that date. They were amputation of the thigh and evulsion of both sides of the great toe-nail. Actually the first operation under ether was performed two days before this by Mr. Robinson, who administered ether and extracted a tooth at the house of Dr. Boott in Gower Street. *The Lancet* published a small sub-leader of thirty lines; it was guarded in character and stated:

> We shall watch its development in the various branches of medicine and surgery which may admit of its application and carefully record them. We suppose we shall now hear no more of the mesmerism and its absurdities as preparatives for surgical operations. The destruction of one limb of the mesmeric quackery will be one not inconsiderable merit of this valuable discovery.

The administration of ether at that time was by the "one dose" method, the operation having to be performed in the few minutes before consciousness was regained. This may account for the opinion expressed in a letter written by Dr. John Ware from Boston and dated November 29, 1846, to the editor of *Forbes British and Foreign Review*, in which he says:

> One of our best operative surgeons informs me that he regards it chiefly applicable to cases of the large and painful operations which are performed rapidly, and do not require any very nice dissection, but that for the more delicate operations which require some time, he would prefer to have the patient in his usual state.

The use of ether spread very rapidly, and the *The Lancet* published frequently accounts of surgical operations under its influence and illustrations of ether apparatus. However, on March 11, 1847, occurred the death of Mrs. Parkinson, thirty-six hours after ether administered for an operation for the excision of an osteosarcoma of the thigh. She had been prepared by two previous short administrations of ether on successive days to accustom her to it. She had probably also been bled, purged, and put on a low diet, as was the custom at that time. The notes of the autopsy record that the liver was paler than usual and softer in texture; from this it seems probable that her death was due to acidosis. As a result of this fatality, as well as of the unpleasant fumes and the post-operative vomiting of ether, many experiments were being made to find a pleasanter anæsthetic. Among the experimenters was J. Y. Simpson, of Edinburgh, who had employed ether extensively in his practice and advocated its use in midwifery. He and some of his friends experimented upon themselves with a large number of substances. In his quest for a suitable volatile drug he had mentioned the matter to David Waldie. Waldie was a chemist at the laboratories of the Liverpool Apothecaries Company. Although he had been educated at Edinburgh as a surgeon and had practised at Linlithgow, he had become more interested in chemical research. Waldie recommended the trial of chloroform, which he was then investigating. It was a substance that had been discovered in 1831 by both Soubeiran and Liebig independently. Simpson obtained a sample, but put it aside. How it came to be tried is best described in the words of Professor Miller:

> Late one evening, it was the 4th of November, 1847, on returning home after a weary day's labour, Dr. Simpson with his two friends and assistants, Drs. Keith and Duncan, sat down to their somewhat hazardous work in

Dr. Simpson's dining room. Having inhaled several substances, but without much effect, it occurred to Dr. Simpson to try a ponderous material which he had formerly set aside on a lumber table, and which on account of its great weight he had hitherto regarded as of no likelihood whatever; that happened to be a small bottle of chloroform. It was searched for and recovered from beneath a heap of waste paper. And with each tumbler newly charged, the inhalers resumed their vocation. Immediately an unwonted hilarity seized the party—they became brighteyed, very happy and very loquacious—expatiating on the delicious aroma of the new fluid. The conversation was of unusual intelligence, and quite alarmed the listeners—but suddenly there was a talk of sounds being heard like those of a cotton mill louder and louder; a moment more and then all was quiet—and then a crash! On awakening Dr. Simpson's first perception was mental—"This is far stronger and better than ether," said he to himself. His second was to note that he was prostrate on the floor, and that among the friends about him there were both confusion and alarm. Hearing a noise he turned round and saw Dr. Duncan beneath a chair—his jaw dropped, his eyes staring, his head bent half under him; quite unconscious, and snoring in a most determined and alarming manner. More noise still and much motion. And then his eyes overtook Dr. Keith's feet and legs making valorous efforts to overturn the supper table, or more probably to annihilate everything that was on it. By and by Dr. Simpson having regained his seat, Dr. Duncan having finished his uncomfortable and unrefreshing slumber and Dr. Keith having come to an arrangement with the table and its contents, the *sederunt* was resumed.

With his characteristic energy, Simpson communicated his discovery to the Medico-Chirurgical Society, and nine days later his paper appeared in *The Lancet*, "A New Anæsthetic Agent, More Efficient than Sulphuric Ether". Before the end of the year he published a further paper, "The Employment of Chloroform in Midwifery".

Chloroform rapidly replaced ether on account of its pleasanter smell, its more rapid action, and the absence of coughing However, in the following year, 1848, there occurred the death of Hannah Greener, who died when a toe-nail was evulsed under light chloroform anæsthesia. An autopsy was performed but threw little light on the matter. There seems no doubt now that death was due to reflex syncope. Simpson wrote to vindicate chloroform and suggested that the woman's death was due to asphyxia caused by the efforts at resuscitation, in the administration of brandy by the mouth. But soon a number of other fatalities were reported in England, Canada and France, and the majority of surgeons returned to the use of ether, except in Edinburgh, where it was considered safe.

Up to this time anæsthesia had been purely empirical. Simpson had begun to administer chloroform without any other knowledge than that the fluid was pleasant to smell, that it had rendered several people unconscious and that none of them had died. He knew nothing of the physiology of the substance and little, if anything, about its chemistry. The first real attempt to place anæsthetics on a scientific basis was by Thomas Wakley, Junior, a surgeon to the Royal Free Hospital, who sent out a *questionnaire* asking for authentic information relative to the action of ether. One of the first investigators was John Snow, who was the first to describe the effects of the inhalation of definite percentages of chloroform vapour and air, and who experimented to discover the manner in which death occurred under chloroform, ether and other anæsthetics. He came to the conclusion that chloroform caused death by primary cardiac paralysis, due to the inhalation of too concentrated a vapour. In 1864 a committee was appointed by the Royal Medical and Chirurgical Society of Great Britain to inquire into the uses and the physiological, therapeutic and toxic effects of chloroform. This committee collected the reports of 109 chloroform fatalities which occurred between 1848 and 1865 and agreed with Snow that the concentrated vapour of chloroform was dangerous, and because of the inconvenience of the administration of ether, recommended the "A.C.E. Mixture". Years later it was shown by Schäfer and Shirley that this mixture was based on a fallacious theory and that it had almost the danger of chloroform.

Although a number of other anæsthetics were introduced, such as ethyl chloride, bichloride of methylene, bichloride of ethidene, they were only of transitory interest. The most generally used anæsthetics were ether and chloroform and they were the subject of research. The first purely physiological research was conducted by the Glasgow Committee of the British Medical Association, whose report appeared in 1879. It was found that blood pressure and cardiac action under chloroform were distinctly lowered. Whilst admitting that although in deaths from this anæsthetic, respiration generally ceased before cardiac action, it asserted that the reverse might occur. This view was in harmony with that advanced by Snow; but it was opposed to the principles laid down by Syme and the Edinburgh school. Syme taught that chloroform never produced primary depression of the heart, and that, provided the respiration was carefully watched and the pulse disregarded, it was a perfectly safe anæsthetic. The dispute raged for the next twenty-five years and will only be epitomized here, as the history of this controversy was so delightfully and fully given by Professor Osborne in the first Embley Memorial Lecture. An attempt was made to settle the dispute by the appointment of the first Hyderabad Commission, with Lieutenant-Colonel Lawrie as director. Lawrie was an ardent supporter of Syme, whose pupil and house surgeon he had been; but he was not a physiologist; so it is not surprising that the findings of the commission supported Syme. These conclusions were not accepted by the medical profession generally, and a second Hyderabad Commission was appointed, with Lauder Brunton at its head. The voluminous report of this commission appeared in 1891, and in all essentials it corroborated the findings of the first commission.

Physiologists throughout the world protested against these findings and showed that there were numerous fallacies in the technical work and that many of the tracings were capable of quite different interpretation. Independent physiological research was undertaken by Leonard Hill, Waller, Gaskell and others; while on the clinical side an investiga-

tion was made by Buxton and sponsored by *The Lancet*. Neither physiological nor clinical findings bore out the statements of the Hyderabad Commission.

It was about this time that Embley became perturbed about the number of deaths from chloroform at the Melbourne Hospital. His clinical observations were at variance with the accepted physiological teaching. With characteristic energy he began to investigate the problem himself. In 1902 he published the result of his research in a long paper entitled: "The Causation of Death During the Administration of Chloroform." In this he disproved the findings of the Hyderabad Commission and correlated his daily problems as an anæsthetist with physiological facts.

Embley's other researches show this same desire to prove experimentally whether his clinical observations were true, and to refuse to accept the work of others without confirmation. He showed that the animal experiments of Schäfer and Scharlieb on the effect of chloroform on the blood vessels were incorrect so far as conditions existed comparable with those of surgical anæsthesia in the human being. His splendid research on ethyl chloride was undertaken with a view to studying its pharmacology, in the hope that this might be of some value to those concerned with its administration, and in order to save what appeared to be a valuable anæsthetic agent from coming under the suspicion of being dangerous. His investigations into the toxicity of different anæsthetics showed that, in the percentages used for anæsthesia, chloroform depressed the heart's capacity for work 51 times more than ether and 19 times more than ethyl chloride. He concluded: "Ether is in every way much safer than chloroform." The so-called "post-operative pneumonia" he found to be due to two causes: first, to waterlogging from inspiration of saliva, mucus or vomited matter, and secondly, to convection of infection from the site of the operation along the lymphatics. He mentioned that Mickulicz asserted that pneumonia occurred relatively more frequently after local than after general anæsthesia. In his paper on "Syncope, Collapse and Shock", he disagreed with Crile and Yandell Henderson and gave reasons and experiments in proof. He pointed out that the employment of strychnine as treatment for these conditions was irrational and advised the use of the intravenous instillation of adrenaline. In a paper entitled "Mixed Narcosis" he gave the result of his experiments with the narcotics combined with ether and chloroform and emphasized the advantages of premedication combined with nitrous oxide and oxygen. In another paper entitled "Chloroform Dosimetry and the Bearing of Some Results of Recent Physiological Research Upon the Practice of Anæsthetics", he pointed out the danger of the use of adrenaline with chloroform, on account of vagal inhibition and of ventricular fibrillation. He also deprecated the use of morphine with chloroform, because of the depression of respiration caused by both. He investigated Goodman Levy's work on ventricular fibrillation, with which he was not quite in accord. He pointed out that Levy only used cats in these experiments, and that their reactions were not similar to those of human beings, whereas those of dogs were similar.

Embley's contributions to this branch of medicine pioneered scientific research and teaching of anæsthesia in Australia. The magnitude of his task can be better understood when one considers that he was in active general practice and also Honorary Anæsthetist to the Melbourne Hospital.

During this period of twenty-five years there had been little advance in anæsthesia, apart from the invention of different methods of administration of ether and chloroform. The next real advance was in 1884, when Koller demonstrated the anæsthetic action of cocaine given by injection. Cocaine, the alkaloid of coca leaves, had been discovered by Niemann in 1859, and its analgesic properties were demonstrated by Schraff in 1862; but little attention had been paid to this action. The hypodermic syringe was introduced by Alexander Wood in 1853; but it was not until 1859 that a cutting point in the needle was introduced by Charles Hunter; before that time an incision had to be made and the needle introduced through it.

Halstead, Corning, Schleich and Bier extended Koller's work. Halstead and Hall also showed that injection of a nerve trunk in any part of its course was followed by sensory paralysis in its entire peripheral distribution. Search was made for other drugs, and tropococaine was introduced by Giesel in 1891. Bier, of Kiel, made many experiments, and conceived the idea of further extending the blocking of nerve trunks by the injection of cocaine into the spinal canal. In 1899 he tried the effect of the injection of 2·0 cubic centimetres of a 1% solution of cocaine into his own spinal canal. The analgesia was so satisfactory that he used the method extensively in his practice and published his work. A wave of enthusiasm for spinal anæsthesia swept over Europe, but was quickly followed by a strong undertow of fatalities. So serious did it become that Bier ceased to use the method until such time as a safer drug was produced. Several drugs were introduced, the most notable being "Stovaine", which was prepared by Fourneau in 1904, and "Novocain", which was obtained synthetically by Einhorn and Uhefelder in the following year. In England "Stovaine" was popularized for spinal anæsthesia by Barker in 1906. Jonnesco began to use it as a spinal anæsthetic for surgery in any part of the body between 1908 and 1910. Still more deaths took place and the popularity of spinal anæsthesia waned.

Ephedrin was introduced in 1928 to prevent the fall of blood pressure which was so frequent with this method. In the following year "Percain", which had been discovered by Charles Miescher, was used by Uhlmann as a local anæsthetic. The prolonged action of "Percain" was noted by Howard Jones, of London, who made

many experiments with it and finally introduced his technique of using large quantities of a solution of 1 in 1,500 for spinal analgesia. This method has overcome most of the dangers and difficulties of spinal anæsthesia and has led to its use in a steadily increasing number of cases.

Nitrous oxide anæsthesia was introduced into England in 1868; but it was looked upon as only suitable for an operation of about thirty seconds' duration. Its many advantages, however, caused a search to be made to prolong its action and prevent its asphyxial element. In 1868, Dr. E. Andrews, of Chicago, had published the reports of several cases in which he had obtained a more satisfactory form of anæsthesia by mixing oxygen with nitrous oxide. His observation failed to attract notice, and it was not until ten years later that the French physiologist, Paul Bert, drew attention to it. Hewitt, in England, and Gwathmey, in America, experimented with it and produced practicable apparatus for its use. Crile's experiments to produce the "shockless operation" did much to place it on a scientific basis; but it required the work done during the Great War to demonstrate its advantages to the world at large. Since that time it has come into more frequent use, until, in America at least, it has become the anæsthetic of choice in many clinics. Both experimental and clinical observations showed that, when nitrous oxide was given with sufficient oxygen, there was no damage done to the bodily organs; renal and liver function, even if previously damaged, suffered no alteration; there was no irritation of the respiratory mucous membrane and the basal metabolic rate was unchanged. Nitrous oxide and oxygen anæsthesia had, however, two disadvantages: muscular relaxation was frequently inadequate and capillary bleeding was frequently increased. This could be overcome very largely by the addition of minimal quantities of ether, or by the administration of more narcotic drugs as premedication. But both these methods introduced again factors which might lessen the harmlessness of the gases. Investigations were undertaken to try to discover some other gases which might have similar advantages, but allow a higher percentage of oxygen to be used and provide greater muscular relaxation. In 1918, Luckhardt and Thompson, in America, began animal experiments with ethylene. They had no knowledge that Herman had anæsthetized himself with ethylene in 1864, that Eulenberg had experimented with it on animals in 1876, or that Lussem in 1885 had anæsthetized frogs, birds, rabbits, dogs and finally himself, using a mixture of 80% ethylene and 20% oxygen. For the next thirty-three years ethylene seems to have been forgotten. Mention of it does not appear in the literature except for the reports of some botanical work in 1901, when Neljubow investigated its effect on seedlings of peas, and in 1908, when Crocker and Knight made similar researches on flowering carnations. Their work was interrupted by the Great War until 1922, when Luckhardt with Carter resumed work on animals. On January 21, 1922, they anæsthetized one another. At the same time W. Easson Brown, in Canada, was working independently on mice, rabbits, cats and dogs. They all made their first publication in March, 1923. In March of the same year a mixture of ethylene and oxygen was first used for a surgical operation at the Presbyterian Hospital, Chicago, by Dr. Isabella Herb.

About the same time Hermann Wieland, in Germany, was experimenting with acetylene, which Rösman, in 1895, had shown to produce anæsthesia in animals. Wieland experimented on animals and on heart muscle in the laboratory for two years and published his first report on "Action of Acetylene". His studies were so gratifying that in 1923 acetylene-oxygen was used for 500 operations in German hospitals. With both ethylene and acetylene it was found that a much higher percentage of oxygen might be given and that muscular relaxation was better than with nitrous oxide and oxygen. But even this relaxation was inferior to that of ether, and both the gases were inflammable and explosive. The next gas to be investigated was cyclopropane, which had first been prepared by Freund in Germany in 1882. Its properties as an anæsthetic were first described in 1929 by Lucas and Henderson, of Toronto, Canada. This was the outcome of research into the toxicity of propylene when used for anæsthesia. Animal experiments were made by Lucas and Henderson, Shackell, Waters, and others. Cyclopropane was then used on human beings in a very careful clinical investigation at Wisconsin by Waters and his associates. Since that time its use has spread rapidly, and by many it is considered to be the most important advance in anæsthesia for many years. Its outstanding advantages are its non-irritating properties and the very high percentage of oxygen that can be given with it. It has, on this account, been found especially useful in major thoracic surgery, such as lung lobectomy.

General anæsthesia by the intravenous route was demonstrated as a possibility by Ore, of Lyons, in 1872, a solution of chloral hydrate being the agent used. After it had been tried in 51 cases, there were fatalities, and the method was abandoned. In 1910, however, the method was revived by Fedorow, of Petrograd, who used "Hedonal" in a 0·75% solution. This was the first of the barbiturates to be used in this manner. A fair amount of success was obtained with it until the war cut off the supply.

In 1920 "Somnifene" was introduced in France for the same purpose, but was abandoned after a fairly extensive trial on account of unpleasant complications. "Sodium Amytal" was described by Shonle and Moment in 1923, and five years later was used intravenously by Zerfas, of Indianapolis, after careful experiments. But its use was abandoned, as it was found that the blood pressure and respiration were greatly depressed, the period of post-operative unconsciousness was too prolonged and respiratory complications were more frequent than with inhalation methods. In 1930, "Nembutal", in

America, and "Pernocton", in Germany, were used in the same manner, and later were discarded for similar reasons, although they are still used for basal narcosis and premedication before inhalation anæsthesia. No really satisfactory drug was found for intravenous anæsthesia until the introduction of "Evipan Sodium" in Germany in 1933. This barbiturate produces unconsciousness rapidly and pleasantly, with much less depression of the respiration and blood pressure than the earlier drugs. It has been found to be safe as the sole anæsthetic for short operations by the use of a single dose; and it has also been used for long operations by a repetition of the injection, or by the continuous method. It has been followed by several similar agents, the best-known being, "Pentothal Sodium", which was introduced in America, and "Eunarcon" in Germany.

From early days attempts were made to administer anæsthetics by the rectal route, so that the field might be unencumbered in operations on the head. Very little success attended these experiments until, in 1913, Gwathmey, of New York, introduced his method of colonic oil-ether anæsthesia. Gwathmey, in collaboration with Baskerville, had performed many careful animal experiments before applying the method to the human being. Colonic ether administration was used extensively, but, except in certain parts of America, has been superseded by other methods. At present the only form of rectal anæsthesia which has much vogue is "Avertin", and even this drug is chiefly employed as a basal narcotic and supplemented by some general or local anæsthetic. It was first produced by Willstatter and Duisberg, German chemists, in 1923, and was first applied to clinical use by Butzengeiger in 1926. Very careful trials were made by selected observers in thousands of cases before it was released for use in foreign countries.

One of the latest introductions in anæsthesia is vinyl ether. Like many of the other agents, it has been known for many years, as it was first mentioned by Semmier in 1875. The first pure samples were prepared by Ruigh and Major in 1931, and it was investigated as an anæsthetic on dogs in 1933 by Leake, Knoeffel and Guedel. In the same year Gelfan and Bell tried it on themselves. In 1934 Goldschmidt and others studied it extensively in man. Its action appears to be rapid, pleasant and safe, and it is particularly useful as an anæsthetic for short operations on children and as a supplement to the gaseous anæsthetics. In some of the dental clinics in England it has supplanted nitrous oxide for children.

Although this résumé of anæsthetic history has been made as comprehensive as possible, it has been impossible to mention every drug and every method of administration; even such important matters as the endotracheal technique, the carbon dioxide absorption method, and the use of helium have been omitted.

The progress of anæsthesia during the last fifteen years has been marked by intense activity. New drugs and new methods have appeared with almost bewildering rapidity. But the keynote has been the careful scientific investigation that has preceded their introduction. The empiricism of the pioneers of anæsthesia has given way to chemical and physiological research combined with meticulous clinical work by specially trained men. The effects of the drugs and methods have been checked by analysis of the post-operative conditions of the patient and by thorough *post mortem* examination where death has occurred. Further advances will undoubtedly be made in the future, and it is by such methods that they will be achieved. The history of anæsthesia shows that, with the exception of chloroform and the very early work, the advances in anæsthesia have mainly been made in America, Germany and France; practically none has been initiated in England. England was the first country in which specialism in anæsthetics became recognized, and the number of good anæsthetists there is large; therefore, it is all the more puzzling to find this anomalous position. In Australia the circumstances are very similar; the standard of anæsthetic work is good and a number of the anæsthetists have done post-graduate work in England and America; yet research, original work, and the introduction of new methods are not common, though a number of good papers have been published on clinical work. But, since the time of Embley, there has, so far as I know, been only one outstanding research in anæsthesia in Australia. This is the work done by a dentist, Noel E. Heath, of Geelong, as a thesis for his degree of Doctor of Dental Science, of the University of Melbourne. It is entitled "A Critical Survey of Anæsthesia and Analgesia in Dental Surgery, with Special Reference to the Determination of the Safest Methods". Unfortunately, the thesis has not been printed except for a short précis of a portion of the work which appeared in THE MEDICAL JOURNAL OF AUSTRALIA, and was entitled "A Consideration of General Anæsthesia for Dental Surgery".

It occurred to me that the explanation of this anomaly might perhaps be discovered by comparing the anæsthetic work of an Australian and an American hospital. The hospitals chosen are the Adelaide Hospital, South Australia, and the State of Wisconsin General Hospital, Madison, Wisconsin. The Adelaide Hospital is the largest general hospital in Australia, having 660 beds (the population of Adelaide is 330,000). Its anæsthetic work may be taken as average for Australia, neither the best nor the worst. The State of Wisconsin General

TABLE I.

Anæsthetic Mortality over a Five-year Period at Adelaide and Wisconsin Hospitals.

Hospital.	Number of Anæsthetics.	Deaths on Table.	Mortality per 1,000.
Adelaide	27,975	38 (Uncorrected)	1·3617
		32 (Corrected)	1·143
Wisconsin	21,121	15	0·71

Hospital has 600 beds (Madison is a city of 50,000 inhabitants). Both these hospitals carry an overload of patients, the number frequently being 700.

The anæsthetic staff of the Adelaide Hospital nominally consists of twelve part-time honorary anæsthetists, who each spend from three to twelve hours per week at the hospital. They are all engaged in general practice, as their income from private anæsthetic work is insufficient to provide a living. Some of these happen to have had considerable experience in anæsthetic work. But when a vacancy occurs there is seldom more than one applicant, and, provided he is a registered medical practitioner, he is appointed to the staff without even any probationary period as an assistant. He need not produce evidence of previous experience, post-graduate study, or the possession of a diploma in anæsthetics. The honorary anæsthetists administer about 60% of the hospital anæsthetics and also supervise the work of the students. The remaining 40% of anæsthetics, including those for nearly all the emergency operations, are given by the house surgeons. This means that many of the most dangerous anæsthetics are given by those whose experience is often very limited. The instruction of students is confined to attendance at five lectures and the administration of twenty anæsthetics under supervision.

A routine examination of patients is made in the ward by the house surgeon; its extent varies according to his available time and enthusiasm. It is supposed to include an estimation of the blood pressure; but this is often missing from the notes. Unless otherwise ordered an injection of morphine and atropine is given as premedication to all adult patients. The anæsthetist rarely sees the patient before he is brought to the operating theatre. A decision must then be made, with the assistance of the case notes and a cursory examination, whether the patient is fit for any operation and what is the most suitable type of anæsthetic. A blood-pressure chart is made during the operation in about 5% of cases; but no anæsthetic record of any kind is kept in the others, except in the dental department, where a record is kept of every case. No routine post-anæsthetic records are kept; in fact it is only during the last two years that even the type of anæsthetic employed has been noted. In 1937 I endeavoured to investigate the anæsthetic mortality of the hospital for the previous five years; but the absence of records made this extremely difficult. After much work, it was possible to obtain a fairly accurate figure for the total number of anæsthetics administered; but it was impossible to discover the numbers of each type. For the major part of this period there was no register of anæsthetic fatalities; therefore, it was necessary to obtain the permission of the Attorney-General to have a search made of the Coroner's records. This information required the services of a special clerk for three days. The number of anæsthetics estimated to have been given to in-patients in this five-year period was 27,975, and the number of fatalities on the operating table was 38. This represents a mortality of 1·3617 per thousand. As six of these patients died from hæmorrhage or other conditions rather than the anæsthetic, the number may be reduced to 32, which gives a mortality rate of 1·143 per thousand.

In Adelaide there is often a long delay before new agents or methods can be used, as in a Government hospital it is a long and complicated matter to obtain new apparatus. For some two years the two main operating theatres at the Adelaide Hospital had to share one gas machine between them, so that if a gas anæsthetic was in progress in one theatre any patient in the other theatre requiring gas had either to wait or else to have ether instead. As another instance of this may be cited the use of cyclopropane. This gas was first administered to human patients by Ralph M. Waters, of the University of Wisconsin, in December, 1930, and in the year 1937 it was employed there 2,206 times. In Adelaide it was used once in 1937, and on that occasion by an anæsthetist from another State, who supplied his own apparatus and brought his own cyclopropane. The Adelaide Hospital did not obtain an apparatus permitting its use until October, 1938, in other words nearly eight years after Wisconsin.

The anæsthetic service of the Wisconsin General Hospital is staffed by a whole-time personnel. In 1935 it consisted of Dr. R. M. Waters as director, with two permanent assistants and two assistants appointed for a year; it has grown from this to a staff of ten. The seniors have the right to fees for the few private patients for which the hospital provides. The patients are examined by one of the anæsthetic staff on admission, and a very comprehensive record form is filled in, an estimate of the risk is made, the premedication ordered and the type of anæsthetic chosen. This form accompanies the patient to the operating theatre, and on it are recorded the blood-pressure readings, which are taken as a routine. After the operation the patient is visited by the anæsthetist as frequently as is necessary for the recording of his progress and for any incidental complications to be added to the record. When the record is completed it is sent to the anæsthetist's office, where the information is transferred to a record card used in the Hollerith system of recording. There is a machine capable of punching, when certain keys are struck, various selected holes in any of the 80 columns, which give 450 different details. This work is performed by the anæsthetists themselves. Once a year the cards are sorted for statistical purposes. If at any time any particular information is required it may be obtained very quickly by passing the cards through a sorting machine. There is a movement on foot in America for the use of a standard card, so that the information and statistics for the whole country may be available. The value of this system is apparent in a study of the effect of new methods and techniques, and has proved its value in the work of Waters and his associates on carbon

dioxide absorption methods and the introduction of cyclopropane anæsthesia. The instruction of students is most comprehensive; they are required to complete a course of anæsthesia upon animals before entering on a five weeks' full-time attendance on clinical anæsthesia. I wrote to Dr. Waters asking for certain statistics, and they were received almost by return mail; amongst them was the number of deaths on the operating table during a five-year period similar to that quoted for the Adelaide Hospital. There were 15 deaths in a series of 21,121 anæsthetics, which gives a mortality rate of 0·71 per thousand, which is about half the rate quoted for Adelaide. Research at the Wisconsin General Hospital is facilitated by the close cooperation between the anæsthetic staff and the physiological and pharmacological departments of the University. During the last ten years there has been a constant stream of careful and valuable anæsthetic research, which is known internationally. The anæsthetic equipment of the hospital is lavish, expense is scarcely considered, and where new apparatus is thought to be necessary it is promptly made available. To the part-time honorary anæsthetist the conditions at the Wisconsin General Hospital appear to be ideal and a personal communication from Dr. Waters is worthy of note. He writes:

> I have had experience with attempting to carry on worth while work in anæsthesia on a private fee basis and I have also had experience working for this institution for a period of over ten years where I am paid a salary by the University and hospital and I am allowed private fees on the few private patients for which we provide. Working on this full time basis as clinical anæsthetist, teacher and co-operator with the laboratories and other clinicians in research effort, I find my state at present a very much more productive one, resulting in greater happiness to me and I hope permitting a greater contribution to medicine. It seems to me that full time positions of this sort are necessary in every institution whether it be a teaching institution or not.

This statement of Dr. Waters probably sums up the reason why major research in anæsthesia is frequently found in America and is very rare in England or Australia, and also why the anæsthetic mortality at the Wisconsin General Hospital is almost half that at the Adelaide Hospital. A specially trained man, devoting the whole of his time to anæsthesia, with an assured income, adequate equipment, and active cooperation with the departments of physiology and pharmacology, can produce much better results than one who has had no special training for his work, one who is only able to devote a short time each week to his subject because of the struggle to earn a living, who has to work with inferior or old-fashioned equipment and without the time to cooperate with the other research workers in the university.

In making this comparison I have chosen Adelaide as a type common to Australia and England and not as the worst example. Wisconsin is quoted because it has probably the best organized department of anæsthesia in the world and is therefore to be held up as an ideal.

The future evolution of anæsthesia is difficult to predict; but there is little doubt that it will be achieved by careful scientific research of the type which has been carried on for the last ten years by Dr. Ralph Waters and his associates at the Wisconsin General Hospital, rather than the somewhat haphazard methods that are so common in England and Australia. There are men in Australia who are quite capable of carrying out similar work if they had equal opportunities and encouragement. In England a start has been made by the establishment of the Nuffield Professorship of Anæsthetics in the University of Oxford. Mr. R. R. MacIntosh, F.R.C.S. (Edinburgh), was appointed to this Chair in 1937. He was anæsthetist to the Throat Hospital, Golden Square, and lecturer in anæsthetics to the National Dental Hospital, and was well known for his work in anæsthetics for operations on the upper air passages. There are at present working under the professor four assistant anæsthetists, a physiologist, and another doctor whose duties are to follow up post-operative histories and to perform biochemical investigations. In Australia it may not yet be possible to establish a department of this magnitude, but certain changes might be made with great advantage. The honorary system, as applied to anæsthetics, has outlived its era and should be discarded; it should be replaced by the appointment of adequately paid, whole-time men who have been specially trained for the work. Each university should appoint a professor of anæsthetics whose duties should include the instruction of students, the correlation of the work of the different teaching hospitals and research. It would be necessary to provide sufficient staff with accommodation and facilities for cooperation with the departments of physiology and pharmacology. Each hospital should have a department of anæsthetics in charge of the senior anæsthetist, with other paid assistants according to the size of the hospital; the junior assistants would be resident officers appointed for a minimum period of one year. The senior anæsthetist would arrange for the proper examination of patients, the choosing of premedication and type of anæsthetic and the keeping of records and statistics. The time allotted to the teaching of students should be increased and the instruction should include lectures, demonstrations and a definite continuous period of anæsthetic clerking. Anæsthetics in private practice would be administered by either the specialist in anæsthetics or the general practitioner. The importance of the specialist has been recognized by the Representative Body of the British Medical Association in their resolution which states: "That the Association appreciates the value of the specialist anæsthetist as an important unit of medical practice, both in hospital and in private practice, and recognizes the right of the anæsthetist to assess and collect his own fees." For this resolution to be of real value, the surgeon and the public must be taught that safety lies in having an expert anæsthetist and that like any other expert, if he is to obtain a

living as such, he must be well paid, otherwise he cannot devote his whole time to the specialty. It will probably always be necessary for the general practitioner to give some anæsthetics; but it should be recognized that the fact that he has referred a patient to a surgeon is insufficient evidence that he is the most suitable anæsthetist for the case. There are many cases in which special knowledge, experience and technique are essential, owing to the serious condition of the patient or the dangerous nature of the operation. However, under this suggested scheme the general practitioner will have had better instruction, more experience, and the opportunity to attend post-graduate refresher courses in anæsthetics.

The scheme that has been outlined will require the expenditure of a fairly large amount of money and may, at first sight, appear to be Utopian; but, if it has been possible at the University of Wisconsin, in Madison, which is a city of 50,000 inhabitants, it should be practicable in Australian cities with a population many times larger. The result would not only be the more rapid advance of scientific research, but the prevention of many unnecessary deaths each year. At present there is an exceedingly large amount of clinical material which is almost entirely wasted. The magnificent work carried out single-handed by Embley should be a stimulus for further research which would be a memorial worthy of this pioneer in anæsthetics.

THE ROLE OF IODINE (POTASSIUM IODIDE) IN EXPERIMENTAL HYPERTHYREOIDISM.[1]

By VICTOR MARTIN TRIKOJUS.

(From the Department of Medicine, University of Sydney.)

IN 1929 Loeb and Bassett,[14] Aron,[4] Uhlenhuth and Schwartzbach[33] first recorded independently the preparation of thyreoid-stimulating extracts from the pituitary gland, and it is now well established that by injections of the specific thyreotropic hormone into a suitable laboratory animal, such as the guinea-pig, symptoms may be evoked which resemble many of those associated with primary Graves's disease in man (Loeser, 1936;[18] Junkmann, 1936[10]). However, the hypothesis that the thyreotropic hormone plays an important part in the ætiology of exophthalmic goitre still rests upon insecure foundations. According to Means[25] (1937) the absence of reliable evidence of increased thyreotropic activity in the blood or urine in human thyreotoxicosis would preclude the acceptance of such a hypothesis. In this connexion it may be remarked, however, that the presence of detectable quantities of the thyreotropic hormone in the blood is not, in the experience of this laboratory, a necessary consequence of even the injection of large doses of the hormone into a laboratory animal or man. It is possible that the hormone may circulate in some modified form, its full effect being made available only under suitable conditions in the neighbourhood of the thyreoid gland, upon which, according to the work of Eitel, Krebs and Loeser[6] (1933), Okkels[27][28] (1937) and others, its specific action is directly exerted.

On the other hand, it was early observed that when injections of the thyreotropic hormone were continued over long periods, the initial symptoms of hyperthyreoidism became diminished in severity rather than aggravated, the thyreoid, indeed, undergoing involution to a state eventually resembling that observed in hypothyreoidism. This fact provided a definite obstacle to the attempts to reproduce artificially the extreme symptoms of acute thyreotoxicosis in the human subject. The phenomenon has been ascribed by Anderson and Collip[3] (1934) and others to the gradual development in the blood of "antihormones" which neutralize the effect of the administered hormone, and the theory was applied by Collip to pituitary hormones in general.

Recently, however, Loeser[19] (1937) has shown that by progressive increase in the dose of the injected hormone the normal diminution in the degree of response on the part of the animal (guinea-pig) may be overcome, the induced hyperthyreoidism increasing in severity so that within two or three weeks a lethal thyreotoxicosis develops. The liver and kidneys of the animals showed evidence of diffuse necrosis and fatty degeneration, which was absent in the organs of control animals receiving the same total quantity of hormone administered in equal daily doses. Should the interpretations of Loeser be correct, it would seem that his conditions enable one to simulate experimentally much more closely than previously the clinical picture and course of acute hyperthyreoidism in man.

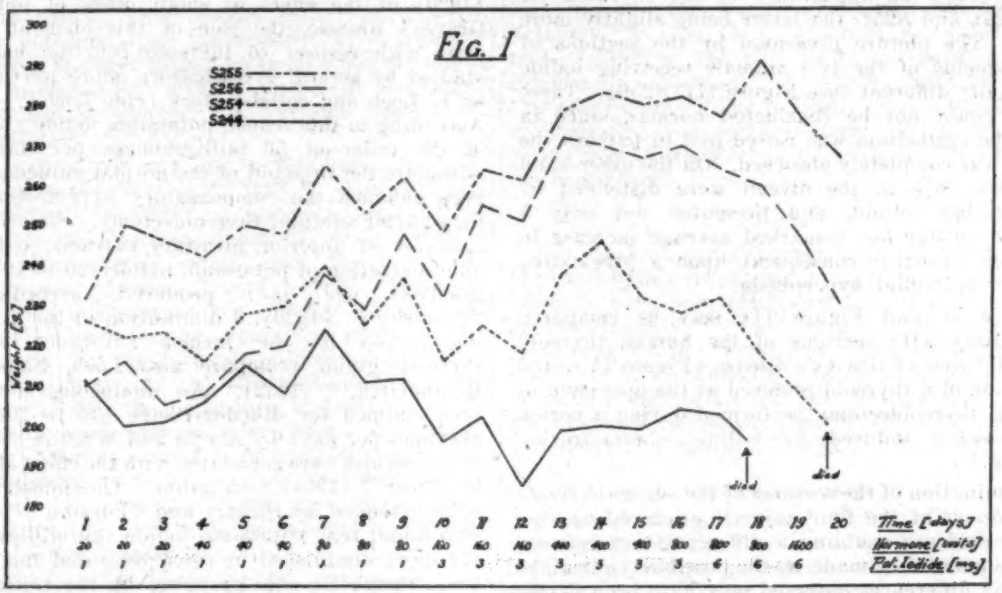
The purpose of the present investigation has been to test the relationship of Loeser's experimental syndrome to that of human hyperthyreoidism from the viewpoint of preoperative iodine therapy. In the experiment to be described an attempt has been made to influence the effect of injections of progressively increasing doses of thyreotropic hormone by iodine (potassium iodide) in daily amounts comparable with those used clinically in Graves's disease. Although the number of animals (four) was restricted by the massive quantities of the hormone involved, the differences in the reaction of the two pairs was so striking as to warrant their consideration quite apart from pure coincidence.

Experimental (May-June, 1938).

Four immature guinea-pigs (*S*244, *S*254, *S*255, *S*256), of the same stock and of approximately the same weight, were caged together in a room artificially heated to a uniform temperature, and fed with a liberal diet of bran, water and fresh

[1] This investigation has been carried out as part of a research programme generously aided by a grant from the Australian National Health and Medical Research Council to Professor C. G. Lambie.

lucerne, so that an excess of food was present in the cage throughout the twenty-four hours. The animals were regularly weighed each morning and then given intraperitoneal injections of the thyreotropic hormone[1] in saline solution (one to three cubic centimetres, depending on the amount of hormone to be dissolved). Two of the animals (*S*255, *S*256) received, in addition, injections of potassium iodide in one cubic centimetre of saline solution by the same route. As in Loeser's experiments, the initial dose of hormone was 20 units, an increase in the dose being made every fourth day, as shown in Figure I (see also Table I), where the quantities of administered iodide are also given, namely, one milligramme per day for nine days, three milligrammes per day for the following six days, and six milligrammes per day until the end of the experiment. Injections were continued until both animals receiving hormone alone had succumbed. In the case of *S*244 this occurred during the night between the seventeenth and eighteenth days, after the second dose of 800 units, and in the case of *S*255 during the night between the nineteenth and twentieth days after the first dose of 1,600 units had been administered. On the morning of the twentieth day the two surviving animals were sacrificed by bleeding, the blood being collected in citrate solution and evaluated for antithyreotropic activity. The thyreoid, pituitary and adrenal glands of all four animals were weighed, and then, together with the liver and kidneys, sectioned and submitted to histological examination.



Results.

All animals were possessed of abnormally large appetites, but in spite of the liberal diet, and in contrast to the iodized pair, those without iodide were in poor condition, particularly during the latter half of the experiment, as evidenced, for example, by considerable wasting, most noticeable in the lumbar region.

The weight chart of the iodized animals, however, indicates a satisfactory increase in weight up to the sixteenth or eighteenth day (Figure I). At this point the weights began to fall; but the animals were still in a good physical condition when sacrificed.

The weights of the thyreoids, pituitaries and adrenals are set out in Table I, and these are

[1] I have pleasure in recording my indebtedness to Professor Schoeller, of Scherings A.G., Berlin, for a generous gift of purified ox thyreotropic hormone containing five Junkmann-Schoeller[(9)] (1932) units per milligramme.

TABLE I.
Results of Experiments on Four Guinea-Pigs.

Number.	Initial Weight. (Grammes.)	Final Weight. (Grammes.)	Hormone Injected. (Units.)	Potassium Iodide Injected. (Milligrammes.)	Period of Injections. (Days.)	Thyreoids. (Milligrammes.)	Adrenals. (Milligrammes.)	Pituitary. (Milligrammes.)	Remarks.
*S*244	211	197	3,700	—	17	120	395	8	Died.
*S*254	226	197	6,100	—	19	125	439	9	Died.
*S*255	232	263	6,100	48	19	132	399	8	Survived.
*S*256	210	230	6,100	48	19	107	265	9	Survived.

remarkably consistent, except in the case of the adrenals of *S*256. Microscopically the sections of the pituitaries showed no significant differences; but those of the thyreoids of the two pairs of animals exhibited a striking contrast. The thyreoids of both animals not receiving iodide (*S*244 and *S*254) were characterized by intense activity throughout the gland. Colloid was entirely absent, and there was extreme hyperplasia of the epithelium, coupled with papillary infolding of the alveolar walls, giving rise to considerable reduction and distortion of the lumen of the alveoli. Figure II (section of thyreoid from *S*254) is typical of the appearance of the thyreoids of both *S*244 and *S*254, the latter being slightly more active. The picture presented by the sections of the thyreoids of the two animals receiving iodide was totally different (see Figure III, *S*256). These glands could not be considered normal, since in parts the epithelium was raised and in patches the colloid was completely absorbed. On the other hand well over 50% of the alveoli were distended by well-staining colloid, and presented not only a rounded outline but a marked average increase in diameter, probably consequent upon a preexisting stage of epithelial hyperplasia.

Figure II and Figure III may be compared respectively with sections of the human thyreoid in a fatal case of Graves's disease (Figure IV), and of portion of a thyreoid removed at the operation of subtotal thyreoidectomy performed during a period of remission induced by iodine administration (Figure V).

Examination of the sections of the adrenals, livers and kidneys of the four animals produced no conclusive evidence enabling a differentiation between the two pairs to be made, as the possibility remained that any differences observed may have been dependent upon *post mortem* changes in the two animals that had succumbed. It is considered desirable to reserve a decision until a comparative experiment has been completed in which it is proposed to dispatch all the animals when the thyreotoxicosis is well advanced, but before death has intervened.

The blood (nine cubic centimetres *plus* three cubic centimetres of 3·8% citrate solution and 0·5 cubic centimetre of 10% phenol solution) of the two animals, *S*255 and *S*256, was administered by intraperitoneal injection (two cubic centimetres per day) to a guinea-pig (*S*259). This animal received, in addition, five units of thyreotropic hormone on the fifth and sixth days, and it was then killed on the seventh day. Its thyreoid was only slightly active, indicative of some inhibition by the blood, in spite of the fact that the donor animals had each received a massive dose (1,600 units) of the thyreotropic hormone the day prior to being sacrificed.

Discussion.

In the experiment just described the favourable influence of iodine (as potassium iodide), in doses comparable to those used therapeutically in man, upon the effect of massive doses of the thyreotropic hormone can be inferred chiefly from its effect on the weight and physical condition of the animals and upon colloid storage in the thyreoid. It is true that towards the end of the experiment the weight curve of the animals receiving iodide also showed a rapid fall. Further work is necessary to decide the maximum dose of hormone that can be influenced by optimum doses of iodide; but, under physiological conditions, there is undoubtedly a limit to the rate of production and excretion of the thyreotropic hormone by the pituitary, should the latter be caused to function abnormally.

Since the original observation by Neisser[28] (1920) of the effect of small doses of iodine in Graves's disease, the role of this element or its salts with respect to thyreoid function has been studied by several investigators, more particularly by L. Loeb and collaborators (*vide* Loeb,[13] 1932). According to this school, potassium iodide (in doses of the order of 50 milligrammes per day) can stimulate the thyreoid of the normal guinea-pig and even enhance the compensatory hypertrophy produced after subtotal thyreoidectomy. Simultaneous injection of anterior pituitary extracts, with oral administration of potassium iodide (50 to 100 milligrammes per day) produced, according to Silberberg[32] (1929), a diminution in the stimulating action of the former substance on the thyreoid gland (compare also Loeb, Seibel and Rabinovitch,[16] 1932). An analogous effect has been claimed for di-iodotyrosine (30 to 100 milligrammes per day) by Abelin and Wegelin[1] (1932) whose results were correlated with the effect of iodide by Elmer[7] (1934) with iodine. These observations were extended by Siebert and Thurston[31] (1932), who found that potassium iodide (50 milligrammes per day) diminished or even prevented the rise in basal metabolic rate produced by the injection of moderate doses of anterior pituitary extracts. It should be emphasized that the results of the various investigators mentioned above have been obtained with iodine-containing compounds in doses not comparable with those used clinically. As the result of a detailed study, Friedgood[9] (1935) concluded that, within certain limits, relatively large doses of iodine (above 100 milligrammes of sodium iodide per kilogram) were more effective in inhibiting the thyreoid-stimulating action of anterior pituitary extracts than small doses.

Anderson and Evans[2] (1937) have recently shown that the subcutaneous injection of small quantities of potassium iodide (0·1 milligramme per day) can diminish the increased oxygen consumption normally produced in guinea-pigs by the thyreotropic hormone. These workers used comparatively small doses of the hormone, but found that during the period of the experiment (three days) the thyreoids of both groups of animals showed the same degree of hypertrophy and hyperplasia. This lack of influence of potassium iodide, after a short period, upon thyreotropic activity, as judged by cellular changes in the thyreoid, may also be seen from the sections shown in Figure VI

and Figure VII. Both animals (guinea-pigs) received 20 units of the hormone per day for six days, whilst to one of these (see Figure VII) one milligramme per day of potassium iodide was also administered. The animals were killed on the seventh day. A differentiation can, however, be obtained after injection of these doses of hormone and iodide for prolonged periods. After nine weeks the majority of the thyreoids of a group of guinea-pigs on hormone alone were still uniformly active, whilst in the case of those receiving iodide in addition the glands were characterized by a low epithelium and by vesicles well filled with colloid (Trikojus and Ellis: unpublished investigations).

In the present investigation, however, a pronounced influence upon the histological picture of the thyreoid has been caused by small doses of iodide in the presence of massive doses of hormone which otherwise produce an extreme degree of thyreotoxicosis.

In an iodine tolerance test carried out in a large number of cases, Watson[34] (1938) showed that, compared with normals or patients with hypothyreoidism, there was an abnormally rapid abstraction of administered iodine from the blood in human thyreotoxicosis. Loeb[12] (1926) assumed that in Graves's disease the optimal amount of iodine satisfactory for the hyperactive gland is not at hand, and that this lack may stimulate the gland to abnormal activity; the effect of administered iodine would then be to remove at least some of the abnormal conditions under which the gland functions. Perhaps under experimental conditions some abnormal state in thyreoid function, other than mere hyperactivity, must first be reached before iodine can exert an effect upon the cellular changes in this gland.

According to Marine[24] (1927) iodine acts in Graves's disease by distending the vesicles with colloid, thereby compressing the secretory cells and the intraalveolar blood vessels, and thus obstructing mechanically the release of the thyreoid hormone. A more reasonable hypothesis has resulted from the investigations of Salter (Salter and Pearson,[30] 1936, Salter and Lerman,[29] 1936), who postulates that iodine enters into the reversible chemical process of synthesis and degradation of thyreoglobulin according to the law of mass action. Eason[3] (1938) suggests that the response to iodine may be concerned with a reduced circulation of the blood through the gland. Of more interest in the present investigation have been the observations by Kuschinsky[11] (1934) and Loeser[17] (1934) on the modified thyreotropic hormone content of the pituitary, induced by administered iodide. Using the rat as the laboratory animal, Kuschinsky showed that the stimulating effect of large doses of potassium iodide on the thyreoid gland could be correlated with an increased production of thyreotropic hormone in the animal's own pituitary, whilst Loeser found a diminished content with small doses. Moreover, since iodide was without effect on the thyreoid of the hypophysectomized rat, Loeser and Thompson[21] (1934) concluded that iodine exerts its action via the pituitary. Unless, however, as seems unlikely, the guinea-pig normally produces and excretes the thyreotropic hormone in quantities commensurate with those involved in the experimental part of this paper, it seems difficult to reconcile this conclusion as the sole explanation of the results under discussion. It may further be remarked that although the hypophysectomized rat has proved of value in the evaluation of thyreotropic extracts, such animals may prove unreliable where function is under consideration, particularly owing to the possibility of injury to the hypothalamus at operation. Loeb, Bassett and Friedmann[15] (1930) and others (for example, Loeser, Ruland and Trikojus,[20] 1938) have observed an anti-thyreotropic effect on the part of thyroxine and allied compounds. Mahaux[22][23] (1936, 1937) considers this effect of thyroxine to result from a blocking of the hypothalamic nerve centres. Whether iodine exerts part of its effect in this way is still a matter for conjecture.

Summary.

The observations of Loeser upon the lethal effect of progressively increasing doses of the thyreotropic hormone have been confirmed in a limited number of guinea-pigs. It has further been shown, as judged by weight curves and the general physical condition of the animals, and the sections of their thyreoids, that this effect can be inhibited by the simultaneous administration of clinically comparable doses of potassium iodide.

Acknowledgements.

I am indebted to Dr. A. J. Canny, of the Department of Pathology, the University of Sydney, for his helpful advice during the examination of the sections; to Dr. N. R. Wyndham for supplying the sections of the human thyreoids and relevant case notes; and to Mr. S. Woodward-Smith for taking the photographs.

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THE POSITION OF ORTHOPTICS IN HEADACHE FROM EYE STRAIN.

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Sydney.

THE subjective symptoms of eye strain are expressions of fatigue of the intrinsic and extrinsic ocular muscles. The rapidity of onset and the intensity are in direct proportion to the fatigability of the muscles and the height of the threshold for pain. The fatigability of the muscles is governed by the amount of effort expended and the reserve force, the threshold for pain by the sensibility of the patient and his vital reserve. Thus until reserve force is becoming exhausted, either by too long sustained effort or undermined general health, no symptoms present themselves, and if a patient's threshold is high, symptoms do not readily reach consciousness. The part played by the external ocular muscles, especially the medial recti, in headache and blurring of vision, is becoming more recognized now that detailed orthoptic investigations are more often carried out. The study of orthoptics in the investigation and treatment of squints is of considerable importance, and has an established position in the investigation of ocular headache and eye strain. It must in time become part of the routine examination. As research is advanced the linking up of orthoptics with investigation of the inequality of the simultaneous retinal images is throwing more light on the production of squint and heterophoria. Convergence deficiency is of such clinical importance that it must be sought for in every patient who complains of headache, whether he presents small or gross errors of refraction or none at all.

If a number of cases in which the patients' refraction has been tested and in which no organic defect has been discovered, are reviewed, it is found that they can be divided up into those in which there is a complaint of visual disturbance, those in which the chief complaint is pain, and those in which these symptoms are combined. The symptoms can be briefly classed in the following way:

Visual disturbances.
(i) Lowered visual acuity owing to optical defect—hypermetropia, myopia and astigmatism.
(ii) Blurring of vision, chiefly at close work or reading.
(iii) Inability to maintain fixed attentive gaze without blurring or screwing up the eyes.

Painful sensations.
(i) Tiredness of the eyes.
(ii) Aching of the eye and brow, beginning unilaterally.

Headache.
(i) Frontal.
(ii) Occipital.
(iii) Fronto-occipital.

Hyperæsthesia.
Chiefly in the occipital region and the neck muscles. Tenderness of the eyes is a hyperæsthesia.

Combined forms.
Optical defect combined with pain.

It is well to recognize that blurring of vision is usually due to a temporary break of convergence, with a fleeting but unrecognized diplopia, causing confusion of the image or ciliary exhaustion and release. Tiredness of the eyes, on further inquiry, is found to include such complaints as blurring of vision, burning of the eyes or headache.

Let us assume that by accurate testing and the prescribing of glasses these patients have been rendered virtually emmetropic (normal sighted). Some of those who complain of frontal and

occipital headache have no errors of refraction, except possibly a small detectable astigmatism, and some have hypermetropia, myopia or astigmatism; but they get little, if any, relief from spectacles. It is obvious that these patients need more than the correction of errors of refraction by spectacles.

When the mechanism of subjective symptoms of eye strain is examined, there is no difficulty in acceptance of the part played by accommodation in hypermetropia and myopia; but when astigmatism, which is singled out as an especially potent cause of eye strain, and to which a list of other conditions, even including epilepsy, is attributed, is considered, difficulties begin to appear. Reference is made to the possibility of the retina's becoming sensitive owing to distortion of the image. Vagueness is the only escape if the inquiries become too pressing. Once it was suggested that by irregular contractions of the ciliary muscle the lens was dynamically distorted in an effort to correct the distortion of the image. It is suggested that in pseudocyclophoria, under the stimulus of image distortion, the oblique muscles attempt to swing the vertical axis.

The net result of astigmatism is lowered visual acuity; the result of lowered visual acuity in hypermetropia is contraction of the ciliary muscle to bring about sharp focus of the image, and, in myopia, contraction of the orbicularis to narrow the palpebral fissure. One can imagine the ciliary muscle's contracting in a wavering uncertainty of the optical state of the eye, and achieving a fluctuating activity that is all in vain. If hypermetropia and astigmatism exist together, a combined extra load is placed on the ciliary muscle.

I have never been satisfied, even when in general practice, that astigmatism deserves the prominence it receives amongst factors producing eye strain. I have always felt that its discovery has overshadowed other possible causes of headache. How often a patient sets out on the rounds from one sight test to another with a small astigmatic error, but an unrelieved headache!

In text-books we learn that the smallest astigmatic error is apt to give rise to most profound symptoms, and the most accurate correction should be prescribed. Every ophthalmologist will agree that his and the patient's endurance is often sorely taxed when the axis and sign of small cylinders are being determined in the tests of refraction of almost normal eyes. Corneal astigmatism is one of the defects of the eye as an optical instrument. The optically perfect cornea does not exist; astigmatism in some measure is universal. Eye strain is not universal, nor does every person wear glasses. Every person who complains of lowered visual acuity because of astigmatism does not complain of headache. All emmetropes do not enjoy ocular comfort, and those who carry small cylinders to correct a small astigmatic error are not rendered free from eye strain. How rarely do we find more than blurring of vision in the acute astigmatism resulting from pressure on and distortion of the eye by chalazions or other swellings, unless extrinsic muscular action is disturbed at the same time.

The disregard of the importance of convergence deficiency is the reason for the failure in a number of cases to give relief by the mere prescription of glasses.

To understand convergence deficiency it is necessary to study the mechanism of binocular vision. I now come to a simple but frequently neglected fact, and I make no apology for stating it: binocular vision is an affair of the two eyes, and the function of the eyes is to give binocular vision in its highest form, stereoscopic vision. From monocular vision to stereopsis the steps are: convergence of the orbital and optical axes forward so that each eye sees the same object simultaneously, and fusion of the images presented to the consciousness. The minute differences of light and shade of the two images result in stereopsis; these differences vary according to the interpupillary distance and the distance from the object of gaze. Coincident with the convergence of the optical axes, the laying down of the Edinger-Westphal nucleus takes place. The close linkage of accommodation and convergence and the exquisite adjustment of the mechanism, which makes possible the maintenance of binocular vision by the extrinsic muscles, will be more readily understood if we study the act of reading these lines. At the left (if the page is assumed to be immediately in front), the optical axes are reciprocally converged; but there is not a constant and equal distribution of contractile force in the two medial recti. The left medial rectus is relatively relaxed, the right slightly more contracted; at the centre the distribution is equal between the two recti, and at the right the right medial rectus relaxes and the left contracts a little more. For each movement of the head and the object of gaze a minute adjustment is effected by the extrinsic and intrinsic muscles. No matter in which relative direction the gaze is placed, convergence of the axes is maintained and the sum of the forces of the medial recti is constant for a given distance. Orthophoria presumes a perfect balance of extrinsic muscles with convergence of as much as, or more than, 40°, and, let me add, a considerable amount of reserve force in the medial recti. Normal binocular vision presumes a stereopsis maintainable at and beyond 40° of convergence. If trouble is taken to make the necessary tests, it will often be found that where a heterophoria exists stereopsis is poor, and fused binocular vision will break when the angle of convergence is dynamically increased to 5° or 10°. This may result in suppression of vision of one eye at the angle of maximum convergence. If the reserve force is low, fatigue manifests itself early, and the subjective symptoms are pain over the area of distribution of the ophthalmic division of the fifth cranial nerve. If it is remembered that the fifth nerve has a descending root, and that at the caudal end the fibres from the ophthalmic division terminate, and that this is in series with the second

and third cervical nerves, there is no difficulty in understanding the occipital pain and hyperæsthesia. The vertex, a field supplied by the maxillary division, is spared.

The factors that make for efficient convergence and normal stereoscopic vision are facial symmetry, correct insertion and coordination of extrinsic muscles, innervational sufficiency, accommodation reflex and fusion, with strong stereoscopic locking of the images. All these factors, and in addition tilting of the head, must be taken into consideration when heterophorias are being studied; and special attention must be paid to the efficiency of the medial recti and to the strength of stereoscopic vision in examining for convergence deficiency. Stereopsis plays an important part in convergence deficiency. Full examination often reveals the fact that those patients whose convergence is almost absent have practically no stereopsis. It is almost possible to say that stereoscopic vision is in proportion to the degree of maximum convergence in any particular case, or that the degree of convergence is in proportion to the strength of stereoscopic vision.

Examination of the eyes is not complete after refraction has been tested and a few rough tests have been made to satisfy a slight interest in the external ocular muscles. The eyes must be dealt with as organs of binocular vision. Simultaneous binocular vision in man has resulted in stereopsis, and so far as using his eyes is concerned, he spends the greater part of his life limited to a radius of one or two metres. The eyes are converged for most of the day, and a constant activity of extrinsic and intrinsic muscles maintains a stereoscopic binocular vision.

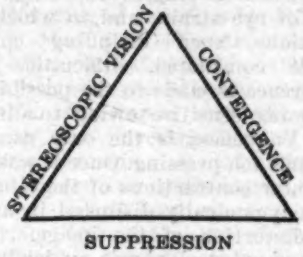
The principles underlying treatment of convergence deficiency are the following: (i) to teach the patient that he has two functional eyes as well as two physical eyes; (ii) to overcome suppression if present; (iii) to establish strong stereopsis, the patient being trained to achieve convergence beyond 40° by means of stereoscopic pictures, followed by pictures to train him in convergence with fusion, and finally simultaneous perception slides. The aim is to establish harmonious coordination and build up a reserve force.

Observations from Practical Orthoptics.

It can be shown that when inorganic lowered visual acuity is present in one eye, and in spite of careful correction of refractive errors no improvement can be brought about, if an orthoptic examination reveals poor convergence and stereopsis so weak that it is almost absent, the visual acuity of the defective eye can be improved by treatment of the convergence deficiency. It is of more than passing interest to note that if convergence is found to be defective, definite improvement in skill at ball games comes about after completion of a high standard of convergence training.

As advance in orthoptics takes place it is realized that there is no sharp division between a slight deficiency of convergence and a 40° convergent squint with a rigid angle and an amblyopic eye.

This great group of patients suffering from potential and dynamic squint meet in a common triangle; the base line represents suppression and the sides represent stereopsis and convergence, respectively. At the apex rests perfect stereoscopic binocular vision. If we remove stereoscopic vision, we fall back on suppression; if convergence fails, again we fall back on suppression.



Failure of convergence may be the result of the lack of reserve force in the medial recti, or of weak or absent stereoscopic locking of binocular vision, or of a combination of these factors. Retreat from the annoyance of double vision in failure of convergence is by way of suppression of the vision of one eye.

Although at the apex of the triangle perfect stereoscopic binocular vision is placed, let us not fail to realize that even here we find suppression. This suppression is physiological and enables us to avoid the double vision of objects beyond the point of gaze. And it must be emphasized that it takes place in the horizontal plane. It is this habit of physiological suppression that makes it easy for pathological suppression to follow readily on faulty balance of the horizontal muscles.

In faults in the oblique and vertical axes there is no habitual physiological suppression to fall back on; therefore the symptoms of cyclophoria and hyperphoria are persistent and severe, because there is no open escape, such as is found in horizontal phorias. There is a persistent but exhausting effort on the part of the extrinsic muscles, aided by head tilting, to maintain binocular vision. It is not surprising to find that patients suffering from vertical and oblique phorias have a strong stereopsis; if this were not so, they would present a manifest squint with amblyopia.

I believe that the constant combination of exophoria with hyperphoria can be explained by the statement that the retreat from the discomfort of hyperphoria by way of suppression in the vertical axis is closed and must be sought for in the physiological horizontal axis, and the first step towards suppression in this axis is found in exophoria.

The mechanism by which suppression is brought about is the same in convergence deficiency as in amblyopia of manifest squint. It varies only in amount. It may be fleeting at certain angles of convergence, or a fixed and rigid inorganic blindness.

ILLUSTRATIONS TO THE ARTICLE BY DR. VICTOR MARTIN TRIKOJUS.

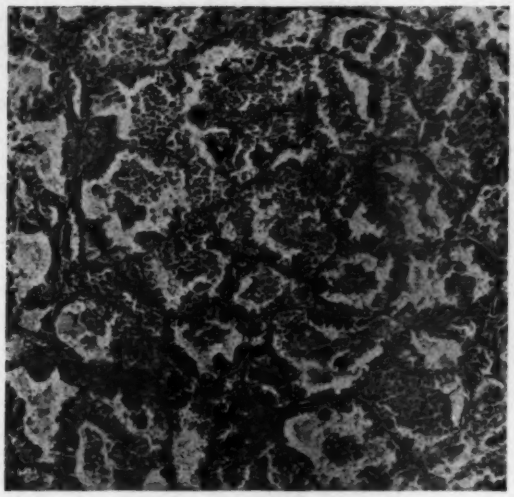


FIGURE II.

Thyreoid of guinea-pig *8254*. The animal had succumbed after receiving a total of 6,100 units of thyreotropic hormone. Colloid is absent and the alveoli are grossly distorted. (×100.)

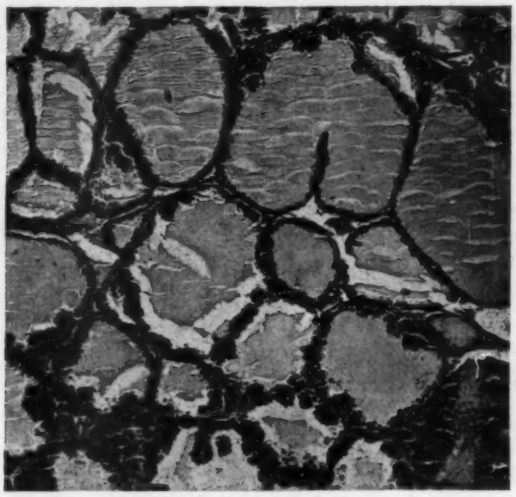


FIGURE III.

Thyreoid of guinea-pig *8256*. The animal had survived after receiving a total of 6,100 units of thyreotropic hormone *plus* 48 milligrammes of potassium iodide. Compare with Figure II and Figure V. Note the highly staining colloid. (×100.)

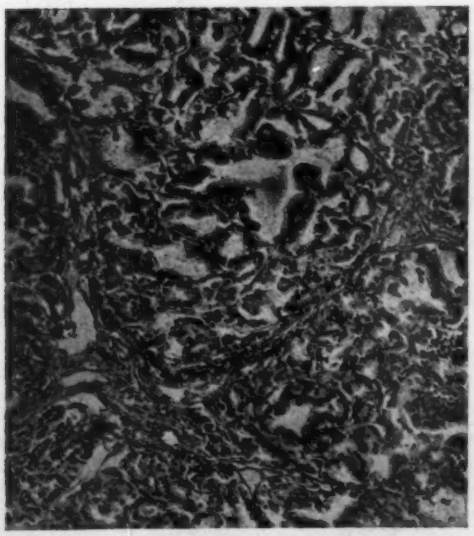


FIGURE IV.

Human thyreoid taken from a fatal case of typical Graves's disease (L.M., a female, aged twenty years). No iodine was given after admission, when the basal metabolic rate was + 54%. The patient died two months later (acute degeneration of the liver). The thyreoid weighed 142 grammes. (Compare with Figure II.) (×100.)

FIGURE V.

Human thyreoid from portion removed at the operation of subtotal thyreoidectomy (F.C., a female, aged thirty-seven years). The basal metabolic rate at admission was + 46%. The patient received five minims of Lugol's iodine solution thrice a day for four weeks before operation. The area of this section has been chosen (as in the case of Figure III) to show the colloid as well as the active centres. (×100.)

ILLUSTRATIONS TO THE ARTICLE BY Dr. VICTOR MARTIN TRIKOJUS.

Figure VI.

Thyreoid of guinea-pig S445. The animal received 20 units of thyreotropic hormone per day for six days. (×100.)

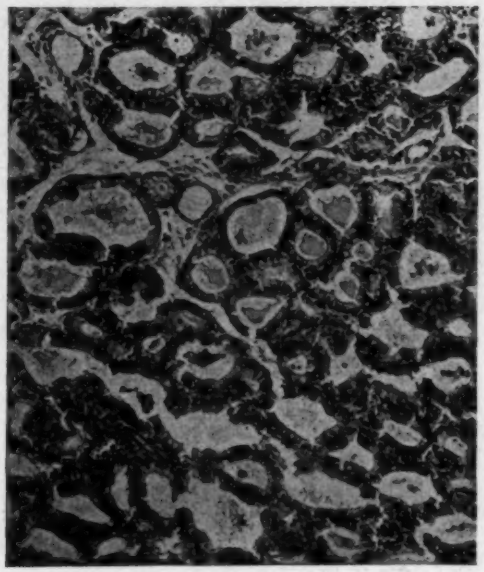


Figure VII.

Thyreoid of guinea-pig S441. The animal received 20 units of the thyreotropic hormone and one milligramme of potassium iodide per day for six days. The degree of hyperactivity is comparable with that exhibited in Figure VI. (×100.)

ILLUSTRATIONS TO THE ARTICLE BY Dr. GEORGE BELL AND Dr. LIONEL LOCKWOOD.

Figure I.

Skiagram taken before reduction of dislocation.

Figure II.

Skiagram taken after reduction of dislocation.

in a manifest squint. It is an escape, not only from the discomfort of diplopia, but from the struggle to master and maintain a stereoscopic picture.

I have not made yet a sufficient number of examinations to enable me to make more than a few suggestions about blinking in children; but I believe that blinking is caused as much, if not more, by binocular discord as by errors of refraction. After refraction is tested, whether glasses are prescribed or not, a child whose parents complain that he blinks, screws up his eyes, tilts his head, or reads with his face almost on the page, should be examined with an amblyoscope. It is necessary to find out to what extent the child is master of his binocular vision. In most cases phorias that are detected in later life must have been present during childhood. Squinting and blinking begin at the same age. Possibly squints are manifestations of failure to master the binocular mechanism, and blinking and allied symptoms are the earliest signs of heterophorias, including inadequate convergence.

There is sound and practical value in orthoptics; and only by the establishment of clinics at the teaching hospitals, in accordance with the example of English hospitals, can its significance be brought to the notice of physicians and students. Orthoptic examination is rapidly finding a position of great importance in the diagnosis of headache and eye strain.

AN OPERATION FOR THE RECOVERY OF PARALYSED MUSCLES IN OTHERWISE NORMAL GROUPS.

By N. D. ROYLE, M.D., Ch.M., F.R.A.C.S.,
Sydney.

THE treatment of paralysis, in poliomyelitis or traumatic partial division of the peripheral nerves, of individual muscles in a group such as the *tibialis anterior* or the gastrocnemius, or of a group of muscles such as the lumbricals or interossei, presents a problem that can be met by a surgical procedure.

Osborne and Kilvington have shown that regenerating nerve fibres do not travel down the original paths, but even cross from one division to another in a regenerating sciatic nerve in the dog.[1] In anterior poliomyelitis degeneration of the peripheral nerve may follow degeneration of the spinal neurone and the nerve trunk may contain normal fibres and sheaths with degenerated fibres. If the nerve is interrupted and allowed to regrow, some healthy fibres will grow into sheaths containing degenerated fibres and so reach the paralysed muscles.

The muscles will regenerate, since I obtained a return of power in four successive patients, in one of whom the *tibialis anterior* was paralysed; in another the whole of the muscles supplied by the median and ulnar nerves. In this patient a nerve suture and transplantation were performed, in addition to a nerve section below the line of transplantation. Details of this and two other patients are given in "Transactions of the Australasian Medical Congress", Brisbane, 1920. To these I now add another typical application of the procedure.

The patient, a boy, aged four years, had a paralysis from injury to the brachial plexus at birth. There remained at the time of examination a loss of power in the hypothenar eminence and of the interosseus muscles of the left hand; but the forearm muscles supplied by the ulnar nerve had recovered. I exposed the ulnar nerve above the elbow and crushed it with a strong pair of artery forceps in several diameters so as to disorganize the axis cylinders and their sheaths. Twelve months later he had regained the function of the interosseus muscles and could extend the interphalangeal joints of his fingers normally. The hypothenar muscles also recovered.

The muscles suitable for this procedure are the *tibialis anterior* which in poliomyelitis often remains paralysed when other muscles of the anterior tibial group recover, the intrinsic muscles of the thumb, the interosseus muscles, the lumbricals, the peroneal muscles, individual muscles of the posterior tibial group, or any paralysed muscles in an otherwise normal group.

The crushing or division of the nerve must be done some distance proximal to its first muscle supply. For example, in the common peroneal nerve it should be done at least five centimetres (two inches) above the origin of the nerve supply of the peroneal muscles and in the ulnar nerve 2·5 centimetres (one inch) or more above the elbow.

The usual orthopædic practice is observed while the recovery of the denervated muscles is being awaited.

Reference.

(1) W. A. Osborne and Basil Kilvington: *Intercolonial Medical Journal of Australasia*, October 20, 1907.

A SEROLOGICAL TEST FOR CANCER: PART III.

By WARNFORD MOPPETT,
Sydney.

Introduction.

PREVIOUS papers[1][2][3] dealt with certain aspects of the movement of cells in an *in vitro* culture and later a serological test for cancer[4] was developed from this work. The results appeared to be about 80% correct when they were positive, but of no diagnostic value when negative. Later, an independent investigator,[5] dealing with greater numbers, obtained results that were over 90% correct when positive and just under 70% when negative. The thermolability of these substances in blood responsible for the operation of the test was then investigated[6] and the improved apparatus used below was described.[7]

Briefly the apparatus consists of a glass plate with two cavities to contain a sample of normal blood and one of test blood, respectively, with a

connecting channel in which is placed a small fragment of the mouse tumour, S37, of the Imperial Cancer Research Fund. The preparation is filled with saline solution, sealed with a cover slip and wax, and the cells around the tumour fragment are drawn initially and after twenty-four hours' incubation.

A positive test result consists in a drift or migration of the cells away from the test blood. The normal blood sample in the opposite cavity may be described as a chemiotactic balance, since the early work[3] indicated that a unilateral blood clot always attracted the tumour cells (positive chemiotaxis).

The present work was undertaken to obviate the necessity of employing a sample of "normal" blood with each test. The requirement is simply a convenient substance to replace the positive chemiotactic effect of normal blood. The test blood should then cause no selective movement if normal, whilst "cancer" blood should result in the characteristic repulsive effect on the cells.

It is immaterial in this investigation whether this is an example of true negative chemiotaxis which was observed in the early work[2] or a positive chemiotaxis to the opposite side due to a deficiency in the "cancer" blood.

Technique.

As clotted whole blood is employed in the test it was thought that agar jelly would provide a comparable structure from which substances would diffuse to produce a concentration gradient in the region of the tumour cells. A 2% solution was used throughout, and for the first experiment 0·95% sodium chloride solution was added (*A* in the table). This gave a slightly higher salt concentration than the saline (0·85%) solution used to fill the apparatus, and the quantities were chosen to reproduce the conditions of early work[2] where similar salt concentrations in water gave rise to positive chemiotaxis to the higher concentration.

In the experiment a convenient number (three or four) of the glass diffusion plates were washed in ether, flamed and smeared with vaseline.[7] Mouse blood was used for preliminary tests, being expressed from the heart as previously described.[3] The agar preparation was meanwhile liquefied by heat, and drops corresponding in size and shape to the blood clot were transferred to the opposite reservoirs by means of a pipette. Small pieces of tumour were then added, being crushed slightly to facilitate the separation of cells, and the slides were completely closed with wax.[7]

Results.

A batch of experiments is recorded below, with the contents of each reservoir of four plates, whilst the final movement of the cells is indicated by the arrows.

Agar	←	Blank
Agar	0	Normal mouse blood
Agar	0	Normal mouse blood
Blank	→	Normal mouse blood

It will be seen that various arrangements were employed with each sample of blood, to diminish the chance of error. For example, the zero results are probably due to a chemiotactic balance and not to failure of the cells to migrate.

The results are summarized in the table as follows: movement to the agar is recorded as +100, and movement to the blood as −100. Thus a positive cancer test would appear as a "+" movement. Slight and doubtful movements are recorded as ± 50, and neutral as 0. The total is then divided by the number of diffusion plates employed, and the result is expressed in the form of percentages in the table. Thus an ideal chemiotactic balance would give 100% positive results when used alone, zero when balanced against normal blood, and +100 with tumour blood. Referring to *A* in the table, a few tests were first made without blood or agar, and none showed any lateral drift of cells (0). With the 0·95% sodium chloride and agar preparation, only about two-thirds showed clear positive chemiotaxis to the agar (+69). When this agar was tried with normal mouse blood the result was not neutral; but the blood was "too strong", drawing the cells away from the agar. This is, of course, positive chemiotaxis; but, as mentioned above, it is recorded as negative, in this case −67, to distinguish from movement to the agar. With blood only the result was −75, and an even higher value might have been expected. However, numbers were small and there are always some plate preparations in which it is impossible to interpret the result, owing to the initial disposition of cells and tumour fragment. Finally, tumour blood was tried with agar of the above-mentioned composition. This blood was obtained from a tumour-bearing mouse, but not from the one supplying the tumour cells, because autologous tumour blood appears to cause positive chemiotaxis[3] under these conditions, and there is less apparent connexion with later clinical results.[4][5]

As might be expected from the above-mentioned result with normal blood, this agar was "too weak", the results (agar tumour blood) being +25.

Accordingly, an attempt was made to increase the chemiotactic attraction of the agar by adding 1% dextrose solution as well as 0·95% sodium chloride solution. These results (*B* in the table) approximate to the requirements, agar normal blood being practically neutral (−8) and agar tumour blood +70. The latter is about the two-thirds majority recommended in a clinical test; but it appeared desirable to try other agar mixtures in the hope of obtaining even better results. In line *C* in the table, a higher salt concentration was tried without dextrose. The results depend on inadequate numbers (two agar blank; four agar blood, two blank blood); but it is reasonable to assume that this agar is unsuitable, and it appears to repel the cells, as did strong salt solutions in previous work.[2]

In series *D* the salt is isotonic with the fluid in the vessel, and it presumably takes no part in the

TABLE I.

Mouse Blood.	Percentage of Sodium Chloride with 2% Agar Solution.	Percentage of Dextrose with 2% Agar Solution.	Number of Observations.	Blank Blank.	Agar Blank.	Agar Normal Blood.	Blank Normal Blood.	Agar Heterologous Tumour Blood.
Ideal chemiotatic balance					+100	0	−100	+100
A	0·95	0	30[1]	0	+69	−67	−75	+25
B	0·95	1·0	30		+58	−8	−88	+70
C	1·95	0	8		−100	−88	−100	
D	0·85	2·0	8		+100	+75	−75	
E	0	2·0	8		0	0	−100	
F	0·95	1·0	12			0		+63
G	0·95	1·3	17			+19		+67
Human Blood.								
B.F.	0·95	1·0	35[1]			−17		+53[2]
G	0·95	1·3	42			+6		+79

[1] Approximately three diffusion plates were prepared from each sample of blood.
[2] If a non-reacting cancer blood is excluded this becomes +64.

effect; but the concentration of dextrose is increased to 2%. From the few experiments it seems that this mixture is too strong. In series *E*, 2% dextrose solution without salt was tried, and the results of four (agar normal blood) tests were neutral; but it was thought better at this stage to carry out further investigations with mixture *B*. Accordingly a similar mixture was prepared (*F*) and agar normal blood is recorded as zero, whilst agar tumour blood is +63, reproducing within the experimental error the results in series *B*. As a slight variation, in series *G* the concentration of dextrose was increased to 1·3% with 0·95% salt solution. This gave occasional positive movement with normal blood (+19) and +67 with tumour blood.

Clinical Tests.

The work summarized above appeared to justify a trial with human blood. A small series of patients with definite cancer and about equal numbers of apparently normal patients were used. As before, three diffusion plates were employed for each patient, but only the totals are recorded. The agar used in *B* and *F* gave −17 with normal blood and +53 with tumour blood. The latter figure becomes +64 if one cancer case which was definitely non-reacting[4] is excluded.

Finally, a few trials were made with the agar mixture (*G*). Normal blood gave +6, and tumour blood gave +79. Bearing in mind that the verdict for each patient rests on at least two out of three preparations,[4] this appears to satisfy the object of the present investigation. The reliability of this technique could be assessed only by means of a large number of tests, preferably by an independent investigator;[5] but facilities are not at present available. In the present series of 14 patients with cancer and 13 normal persons, all findings agreed with the clinical state except the one mentioned above; but the patients were carefully selected.

Conclusions.

A method is described for simplifying the author's cancer test by replacing the normal blood required with agar jelly of a constant composition.

Acknowledgement.

I wish to thank Professor C. G. Lambie, of the Department of Medicine, University of Sydney, for facilities for carrying out the work, and Dr. H. H. Schlink for access to clinical material.

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(2) W. Moppett: "Observations on the Movement of Cells in Vitro", *Proceedings of the Royal Society*, Series B, Volume CVI, 1930, page 175.
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(6) W. Moppett: "The Thermolability of Substances Responsible for the Selective Movement of Tumour Cells in the Presence of Tumour Blood", THE MEDICAL JOURNAL OF AUSTRALIA, July 10, 1937, page 53.
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Reports of Cases.

A CASE OF COMPOUND SUBASTRAGALOID DISLOCATION.

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AND

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WHILE playing football at Rushcutter's Bay on May 9, 1938, C.A.C., an able seaman, aged twenty years, was heavily tackled, and in consequence his left ankle suffered a severe twisting strain. On his admission to Naval Wing, Prince of Wales General Hospital, Randwick, shortly afterwards, a large gaping wound was present on the medial aspect of the left foot below the ankle joint, in which the inferior articular surface of the astragalus was presenting. There was a complete dislocation of the subastragaloid joint. The ankle joint was intact.

Under open ether anæsthesia, approximately three hours after the injury, open reduction of the dislocation was undertaken. *Débridement* was performed after careful cleansing with ethereal soap and ether. Ether, hydrogen peroxide and saline solution were poured into the wound over the dislocated joint surfaces. The dislocation was

reduced with great difficulty by extension on the foot and digital pressure outwards on the astragalus. The joint surfaces were not touched with any steel instruments.

The posterior tibial artery and veins were found to be torn through, and were ligated. The posterior tibial nerve appeared to be intact although contused. The *tibialis posticus* and *flexor digitorum longus* tendons were dislocated, and were returned to normal respective positions after reduction of the deformity.

A medial branch of the *dorsalis pedis* artery was ligated. The deltoid ligament was sutured with catgut, a few catgut sutures were placed in the deep fascia, and interrupted horsehair sutures were used for the skin. The foot was put up in moderate dorsiflection and inversion to relax the skin in the neighbourhood of the wound. Posterior and anterior slabs of plaster were moulded, and circular plaster bandages applied over these. Tetanus antiserum (1,500 units) and gas-gangrene antiserum (10,000 units) were administered at the end of the operation.

A course of "Prontosil Album" was given, four tablets, each of 0·5 gramme (7·5 grains), being given daily for six days.

On June 1 the original plaster was removed, and a fresh plaster applied. The wound had healed. The plaster was split, and removed daily for movements of ankle joints and toes. On June 18 the patient was up on crutches. Physiotherapy was commenced. On August 15 spasm of the *tibialis anticus* and *peronei* muscles had developed. The patient was put to bed to overcome the spasm.

On September 22 the spasm had completely disappeared and the patient could now walk and run well. He had no limp. The joint movements appeared to be perfect. The rating returned to duty.

X Ray Reports.

The following reports on X ray examination were made by Dr. P. Parkinson.

May 11, 1938: The relations of the ankle joint appear normal in the lateral projection, but I cannot see whether there is a fracture of any of the bones. The calcaneus and the tarsal bones are completely dislocated; but I cannot tell in which direction.

June 2, 1938: Old injury to the tip of left lateral malleolus and to the lateral aspect of the talus in good position.

August 19, 1938: The report issued on this date was similar to that of June 2.

Reviews.

THE OCCUPATIONAL TREATMENT OF MENTAL ILLNESS.

A VOLUME on the occupational treatment of mental illness by John Ivison Russell should find an honoured place in every hospital for the care of the mentally afflicted.[1] As Dr. Rees Thomas infers in a foreword, this form of therapy has its roots in the work of Sir William Ellis and Dr. Samuel Tuke more than a hundred years ago, but until the Great War came it was neglected. We would go further and say that this type of book, although designed for a comparatively small number of our population, has a very much wider significance. Occupation by handicrafts is such a lever towards sanity that it should play a greater part in every man's education. Why limit to the invalids a lesson in the art of living which should be learned by the great majority? Only those who have seen wards for the refractory in a mental hospital turned into hives of pleasant industry can perhaps grasp the significance of occupational therapy. Those who have not had this experience must take the author's words as axiomatic. Truth is in this case stranger than fiction.

The author deals with the problem systematically. Commencing with the aims and rationale, he discusses the psychological types which have an intrinsic bearing on the motive of interest. As the role of the physician is to treat, he is taught how to prescribe occupation as a means to recovery. His orders must not be haphazard but carefully considered for the individual patient. Whilst the ideals of occupational therapy are not difficult to grasp, the method loses its efficiency if the organization is faulty. Little details have to be considered and all activities need coordination. The work must be useful, have a disposal value and be under constant supervision. The nurses must be trained to regard it as an integral part of their duties.

The book is highly practical. We are introduced to the structural planning of occupational centres and chapters are devoted to a detailed account of those activities which have been found most beneficial. A brief summary of the latter will illustrate the scope. They include such crafts as woodwork, details of the preparation of glue, specification of timbers used, turnery, woodcarving and the like. Under the heading "basketry" we find such items as methods of weaving and details of basket work. There follows the equipment for brush making and occupations in coir, door mats, skeleton mats, methods of plaiting *et cetera*. Bookbinding, plastic modelling and plaster casting are a prelude to a chapter on miscellaneous occupations which include needlework, weaving, rug making, slipper weaving, wire fencing, *papier mâché* and scrimshaw. The book is such a treasure trove of ideas that every interne of a mental hospital will find in it much food for thought.

[1] "The Occupational Treatment of Mental Illness", by J. I. Russell, M.B., Ch.B., F.R.F.P.S., D.P.M., with a foreword by W. Rees-Thomas, M.D., F.R.C.P., Dip. Psych. Med.; 1938. London: Baillière, Tindall and Cox. Demy 8vo, pp. 247, with illustrations by J. B. Morgan. Price: 6s. net.

NEURO-RADIOLOGY.

INNUMERABLE papers and monographs on the different aspects of neuro-radiology have been published, but the "Textbook of Neuro-Radiology" by Dr. Cecil Wakeley and Dr. Alexander Orley is the only work dealing with the subject as a whole.[1]

The first part of the book is devoted to a consideration of cranial lesions. Special chapters deal with the various projections which have been devised for the visualization of the petrous bone and the cranial foramina. We are reminded that sellar deformities may be of non-pituitary origin and caused by extra-sellar lesions situated either in the immediate vicinity of the *sella turcica* or in the posterior cranial fossa (cerebello-pontine tumours, chondromata, cholesteatomata, meningiomata, aneurysms *et cetera*) or even at a distance from the sella. Minor changes in the sella, formerly regarded as of no significance, cannot be too lightly dismissed when a cerebral tumour is suspected.

A large part of the book is properly devoted to ventriculography and encephalography. Wakeley and Orley attach importance to the twelve Lysholm projections. Ventriculography is considered to be a dangerous operation when entrusted to the hands of persons unfamiliar with cranial surgery. Even under the most favourable operative conditions there is an average direct mortality rate of at least 3%.

Wakeley and Orley do not present any new ideas, but they have collected what is already known and have presented it in a concise form. The large printing and the liberal use of heavy type make the book unusually easy to read. While the diagrams are numerous, the book suffers from a lack of radiographs illustrating the conditions described. The few radiographs that do appear are reproduced as positives—a common practice amongst English and Continental authors. A little extra trouble to reproduce these as negatives would enhance their value immeasurably, particularly for neurologists and surgeons, who become accustomed to examining negatives. Much of the subject matter is treated briefly; but an excellent bibliography is provided. The book definitely fills a gap in the literature.

[1] "A Textbook of Neuro-Radiology", by C. P. G. Wakeley, D.Sc., F.R.C.S., F.R.S.E., F.A.C.S., F.R.A.C.S., and A. Orley, M.D., D.M.R.E.; 1938. London: Baillière, Tindall and Cox. Super royal 8vo, pp. 350, with illustrations. Price: 25s. net.

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CHILDREN'S LEISURE AND LIBRARIES.

As the question of delinquency, with its attendant misdirection and consequent waste of physical and mental power, is often a medical as well as a social problem, the preventive measures instituted and practised by the far-sighted and wise may well be surveyed. Although the expensive Roman custom of providing "bread and circuses" for the unemployed and discontented populace cannot be regarded as an ideal solution, and no one has, as yet, suggested that free picture show tickets be included in the dubious luxuries of the dole, the fundamental idea is sound. By providing amusement for malcontents the Roman authorities showed that they understood the danger to the community of indiscriminate and unwise use of leisure by the individual. Nowadays, applying to preventive measures the principles of occupational therapy, and realizing that the mental and spiritual well-being of society depends upon the state of the unit, we look for, and find, wiser and better provision for the recreation of the people. The extensive and intensive campaigns for better physical education instituted in Great Britain, Germany, Italy and the United States of America, and soon to be launched in this country, have as an end the evolution of a race of physically strong and healthy men and women. If, however, we are to hope for national fitness in its most complete sense we must train minds as well as muscles, and realize that the quiet activities of nursery school, free kindergartens, Boy Scout and Girl Guide and children's library movements must eventually play an important part in producing better citizens, whose social spirit, self-respect and love of beauty and of order have been fostered and fully developed.

The first children's library in New South Wales was established by Mrs. M. Matheson fourteen years ago in one of the poorer parts of Sydney. To it came children accustomed to the drab monotony of poor homes and the unwholesome excitements of the pavement, and there in colourful orderly surroundings they learnt all manner of arts and crafts and games, and discovered that reading could be a pleasure. Clubs for older children and parents were soon formed and later other centres were opened; in one of the latest there is an open-air theatre. At these clubs not only children, but their parents, and especially the mothers, whose lives are too often monotonous and work-bound, are given means of creative expression which enrich their otherwise dull existence. One centre has a physical culture session and library for mothers only. The response of the children has been overwhelming, and we understand that officers of the Child Welfare Department attribute the decrease of juvenile delinquency in one area in Sydney entirely to the influence of its library.

As Maria Montessori's methods, designed originally for subnormal pupils, have been used successfully in the instruction of normal and highly intelligent children, so may the ideals of the children's library movement be applied to other grades of society than that called the lowest. The need of the child is always the same, and is not necessarily met by comfortable economic conditions. The offspring of parents who enjoy what are known as easy circumstances is sometimes more neglected than the young inhabitant of an industrial district, despite his expensive toys and his regular visits to the picture show. The problem of many a "difficult

child" can be solved only by his parents and instructors, and by the family doctor, who, by virtue of his unique opportunities of seeing and hearing what is usually concealed, may sometimes, if he is understanding and wise, be able to end the difficulties of the potential social outlaw or misfit.

We commend the children's library movement to the interest of Australian medical practitioners. Where children's libraries are already established practical help and encouragement can be given; where none have yet been formed medical practitioners, in common with others who seek the welfare of children, may urge their formation and give some practical assistance.

Current Comment.

THE TREATMENT OF PARATHYREOID TETANY WITH DIHYDROTACHYSTEROL.

In spite of conspicuous advances in our knowledge of parathyreoid tetany, treatment of the condition is not invariably satisfactory. C. M. MacBryde points out that, although its relative incidence falls after operations on the thyreoid gland, the actual number of cases is greater owing to the frequency of operations on the thyreoid and parathyreoid glands.[1] Symptoms may be only temporary, but frequently chronic tetany supervenes because of removal of the parathyreoid glands or permanent injury to them or gross interference with their blood supply. MacBryde maintains that the measures employed to alleviate the condition are inadequate. Calcium salts given intravenously and parathyreoid extract administered by the intramuscular or subcutaneous route will give relief from the acute manifestations and temporarily restore the blood calcium to the normal level. Such measures are not suited, however, to prolonged use, and tolerance by the patient to parathyreoid extract often develops. In MacBryde's experience parathyreoid transplants have been ineffective. Combinations of various measures have been found valuable, but MacBryde observes that there have always been many residual disabling symptoms, ranging from mild paræsthesiæ to severe muscular cramps, abdominal pains and convulsive attacks.

During the past year MacBryde has employed a new therapeutic agent called dihydrotachysterol, which is derived from irradiated ergosterol. It has been used in an oily solvent containing five milligrammes in each cubic centimetre. By the oral administration of small doses MacBryde was able for the first time to keep patients symptom free and to maintain the blood calcium at a normal concentration. Tachysterol, like calciferol, is an isomer of ergosterol. The author found that small doses of dihydrotachysterol given by mouth relieved parathyreoidectomized animals of their tetany and raised their blood calcium content to an approximately normal level. Holtz relieved patients suffering from idiopathic hypocalcæmia and parathyreoprivic tetany with this substance, and others have reported favourably on the preparation. With it MacBryde treated seven patients manifesting tetany associated with hypocalcæmia. In the youngest the disorder was of the "idiopathic" type; in the others it followed thyreoidectomy. The patients were all completely relieved of their manifestations. All previous therapy had been ineffectual except injections of calcium and parathyreoid extract, which gave temporary relief. Approximately normal calcium levels were maintained in all the patients with daily doses of from 0·3 to 1·0 cubic centimetre of the drug in addition to calcium gluconate or calcium lactate. One of MacBryde's patients has been symptom free for more than a year, one for seven months, two for six months, and two for three months. No tolerance was noted. In no case was it necessary to increase the dose and in several a smaller dose than that originally given was found sufficient to keep the blood calcium content normal. Dihydrotachysterol alone, according to MacBryde, will increase the serum calcium to normal, but, when no calcium is added to the customary diet, daily doses of from one to two cubic centimetres of the solution are required. In the blood of all the patients the rise in calcium was as pronounced as was obtained by means of parathyreoid extract. After administration of the extract the rise is generally noted in a few hours and attains a maximum in three to eight hours. It disappears in 24 to 48 hours. After the exhibition of dihydrotachysterol the first increase is observed in about 48 hours. When small doses are administered, the rise continues until normal calcium levels are attained in from seven to fourteen days. The dose can then be diminished and a normal serum calcium content be yet maintained. The phosphorus content of the blood tends to rise slightly at first; but this is followed by a slow decline as the calcium concentration approaches normal. The effect of tachysterol on the calcium content persists for a considerable time. After cessation of the drug there is a slow fall and previous levels are regained in one to three weeks. With larger doses a more rapid increase in the serum calcium occurs, but overdosage may be dangerous on account of the development of slow, cumulative effects with the resulting hypercalcæmia.

MacBryde asserts that dihydrotachysterol is superior to parathyreoid extract in that its effect is more stable and it retains its potency when kept at ordinary room temperature. Further, it can be administered by mouth and is less expensive than its competitor. Physicians must bear in mind, however, that owing to its very potency excessive doses

[1] *The Journal of the American Medical Association*, July 23, 1938.

may cause hypercalcæmia and induce severe toxic effects. There is great individual variation in the response to this drug. Only small amounts are necessary, and frequent determinations of the calcium content of the blood must be made until maintenance dosage has been established. Decalcification of bones and metastatic calcification have followed the giving of large doses to laboratory animals. The mechanism of the drug's action has not yet been completely elucidated. Investigations of the calcium and phosphorus balance are being made to ascertain whether or not an increased storage occurs and whether the increase in blood calcium is derived from the gastro-intestinal tract or from the bones.

THE SULPHANILAMIDE TREATMENT OF TRACHOMA.

WE have still much to learn not only concerning the pathogenesis of trachoma, but also concerning its treatment, which remains far from satisfactory. Sulphanilamide has now been added to the therapeutical armamentarium. F. Loe and his associates have been experimenting with this drug since August, 1937.[1] They began by trying it upon two patients suffering from trachoma. One had been afflicted with the disorder for two years, and the other for eighteen months. Both patients had had grattage with subsequent applications of silver nitrate, but no obvious improvement had followed. For each pound of their body weight they received 0·02 gramme (one-third of a grain) of sulphanilamide and an equal quantity of sodium bicarbonate daily for ten days. The dosage was then reduced to 0·016 gramme (one-quarter of a grain) and given daily for a period of fourteen days. During this time no other medication was exhibited. Within five days of the inception of the treatment changes in the conjunctiva were obvious. Redness of the lids gradually faded, granules and papules diminished in size, and the blood vessels became increasingly visible. The two patients seemingly were cured of trachoma within one month. So far neither has had any recurrence.

In the beginning of 1938, Loe and his associates instituted the sulphanilamide therapy of thirteen patients who had been under continuous treatment for trachoma for periods ranging from one to seven years. Three were discharged in ten days, apparently cured. The other ten showed conspicuous improvement within eight days, but received treatment for a further two weeks. Altogether, 140 patients were treated on the lines indicated. Improvement was manifest by a cessation of lachrymation and loss of photophobia within twenty-four hours. In cases complicated by pannus vision improved within seventy-two hours. Relief of the objective manifestations was seen in paling of the conjunctiva and of the trachomatous patches, with flattening of the granules and follicles. After three weeks of treatment a few flat-topped granules remained, and only after some months did they disappear entirely. During these months, however, medication was suspended. Ninety-three patients treated in boarding schools during January, 1938, and discharged as improved, are still examined at intervals of a month, and although given no further treatment they continue to maintain improvement and are free of exacerbations. On May 12, 1938, slight activity of the disease was noticed in twelve. In the patients who showed no scarring from instrumentation, the conjunctiva regained its normal velvety texture at the end of two months. The conjunctival blood vessels became more visible on the fifth or sixth day of treatment, and thenceforward became daily more normal. In thirty cases of pannus it was noted that the opacity began to clear between the eighth and the fifteenth days; vision therefore greatly improved. The last objective manifestations to disappear were the granules on the lower lids. The reactions following treatment were extremely mild and scarce. In three cases dermatitis ensued, but cleared up without sequelæ three days after the sulphanilamide was discontinued. Four patients complained of mild vertigo and headache. When the drug was withdrawn for twenty-four hours these symptoms subsided and treatment was resumed. In no case was pyrexia noted. Loe admits that it is too early to speak of the results as a "cure", and remarks that standardization of the treatment is not yet possible, as not every patient responds in like manner.

In the discussion which followed the reading of Loe's communication, H. S. Gradle remarked that he had treated twenty-five Indians by the same method. Five, however, had to discontinue the sulphanilamide on account of headache, nausea or actual cyanosis. The impression gained by Gradle, from three weeks' observation of the patients treated with sulphanilamide, accompanied only by a cleansing conjunctival wash of normal salt solution, was that trachoma in the second and third stages responded remarkably in that the velvety patches and hypertrophied areas quickly disappeared. The thickened and hyperæmic conjunctiva became thinner and pale. Individual vessels became visible, and in most of the cases the secretion disappeared. Gradle considers that three weeks of sulphanilamide medication give results as good as those of local treatment extending over three to six months, but without scar formation. Photophobia and lachrymation rapidly subsided regardless of the stage of the infirmity, with gratifying relief to the patients. In certain forms of trachoma there was conspicuous improvement in the patient's vision when it had been diminished by pannus. However, in the older and more severe cases and those in which there were corneal scars resulting from old ulcers, any visual improvement was negligible. But sometimes visual results were almost miraculous. Gradle issues the warning that the drug is not without danger and should be taken only when continuous medical observation is possible.

[1] *The Journal of the American Medical Association*, October 8, 1938.

Abstracts from Current Medical Literature.

DERMATOLOGY.

Match and Match-Box Dermatitis.

A DESCRIPTION of a personal experience forms the basis of discussion of match and match-box dermatitis by Robert Klaber (*The British Journal of Dermatology and Syphilis*, August-September, 1938). The author describes an eruption which occurred on his own person on two separate occasions (in the late spring of 1935 and 1937) when he was staying in the north of England and in Scotland. The eruption first appeared on the hands, spreading after a day or two to the face, and was associated with intense irritation, blotchy redness and some exudation. The second attack was more severe than the first, and after a few days spread to an area on the upper part of the front of the left thigh at the same time as the face became involved. On each occasion the left hand was the more involved, and during the second attack was mostly affected with a vesicular eruption involving the thenar eminence and the front of the proximal phalanx of the ring finger. Close consideration of the possible factors disclosed the fact that the eruption on each occasion followed the use of matches of the "strike-anywhere" variety, in common use in the north of England and in Scotland. The writer habitually carried the match-box in his left trouser pocket. It was also shown that the areas involved on the left hand corresponded to the skin in contact with the striking of the box surface. The author points out that the compound phosphorus sesquisulphide is present in the heads of "strike-anywhere" matches, being transferred to the striking surface of the box only after the matches have been struck on it. He points out that in England both safety-match heads and safety-match boxes are free from this compound, but that some cases of dermatitis have been reported from Germany and America when phosphorus sesquisulphide has been substituted for red phosphorus in the manufacture of safety-matches and boxes. Other factors determining the occurrence or not of dermatitis are discussed, such as the habits of the user of "strike-anywhere" matches, heat, humidity, hyperidrosis and hypersensitivity. Controlled patch tests performed on the author in collaboration with H. Corsi elicited positive reactions to used match-box striking surfaces on the author himself, no reaction occurring on the collaborator. The writer, in conclusion, points out that the condition of match-box dermatitis is not sufficiently common to warrant the prohibition of phosphorus sesquisulphide in match heads, but that manufacturers should be aware of the existence of the hazard. He deprecates the sporadic use of the compound in safety-match boxes.

Plummer-Vinson Syndrome.

NELSON PAUL ANDERSON (*Archives of Dermatology*, May, 1938) calls attention to the dermatological features of a syndrome variously designated as dysphagia and anæmia, dysphagia of anæmic women, idiopathic hypochromic anæmia and achylic chloranæmia, but better known as the Plummer-Vinson syndrome. Most of the early writers who described the Plummer-Vinson syndrome entirely overlooked the condition of the nails or did not deem the changes of sufficient importance to be included in their reports. In 69 cases reported by Vinson from the Mayo Clinic in 1922 there was no mention of the nails. Moersch and Conner reported 65 cases from the same clinic four years later, and failed to mention the condition of the nails. In recent years, however, observers in England, Germany and France have called attention to the spoon-shaped nails accompanying a definite type of anæmia. This fact should not be interpreted to mean that anæmia alone causes spoon-shaped nails. Pardo-Castello reported spoon-shaped nails with *lichen planus*, and with syphilis as described by Howard Fox, with *acanthus nigrans*, with prolonged cachexia, with monilethrix as described by Walzer, and also in certain dystrophic states and possibly secondary to fungus infections. The anæmia, the most consistent and striking feature of this syndrome, has been present in every instance. Women, for this syndrome is practically confined to females, present a definite and peculiar pallor, which at times closely resembles that of pernicious anæmia. In over 200 cases reported the changes in the blood are those of a mild secondary anæmia. The red blood count averaged about 4,000,000 per cubic millimetre; the hæmoglobin content was reduced approximately to 50%; fragility of red blood cells was noted in six cases. Changes in mucous membranes are fairly common, and involve lips, tongue, buccal mucosa, pharynx and the upper part of the œsophagus. Dysphagia, which is present in many cases, begins suddenly, often following a severe nervous shock. Attention has been called to the possibility of malignant disease in the late stages of this syndrome. McGibbon reported œsophageal lesions in six of seven cases, and in the seventh there were multiple malignant newgrowths of the buccal mucosa. Ahlbom has observed 250 women with squamous-cell carcinoma of the mouth, pharynx and œsophagus. One hundred and fifty of these were examined and questioned, and 70% gave a history of symptoms suggesting achlorhydric anæmia or the Plummer-Vinson syndrome. Treatment of the Plummer-Vinson syndrome consists in relief of the dysphagia by mechanical measures, accomplished by the passage of an œsophageal sound or dilator, a single treatment often relieving the dysphagia for many months. The anæmia is best treated by iron and ammonium citrate; liver extracts proved disappointing when used alone, but were very effective when combined with iron. With disappearance of the dysphagia foods high in iron and vitamin content can be added to the diet.

Neurodermatitis.

GEORGE MARCHMONT-ROBINSON (*The Urologic and Cutaneous Review*, December, 1938) describes a new method of treatment for neurodermatitis, in which he includes lichenification, lichenified eczema, *eczema nuchæ* and *lichen simplex*. There are two distinct types of the affection: circumscribed and disseminated. The objective symptoms are lichenification, more or less acanthosis and parakeratosis, excoriation and at times exudation. The subjective symptom is itching, which may be intense and often precedes the eruption. Since in pernicious anæmia and this disease are found fissuring of the tongue and apparent atrophy of the mucous membrane of the mouth, disturbances in the sense of taste, recurrent sore mouth, abdominal distress, indigestion, anorexia, along with cramping coldness, tingling numbness and hyperæsthesia of the skin, the author decided to use a hæmatinic preparation in the treatment of these cases. He gives three examples (of many cases) in which he has had excellent results by the intramuscular injection of 0·5 cubic centimetre of parenteral liver extract with vitamin B_1. The patients obtained relief from their symptoms within half an hour to a few hours. The author considers that: (*a*) there is a definite hepatic causal relationship between skin manifestations and the nervous symptoms, possibly due to lack of synthesis of toxins in the liver; (*b*) the elaboration of toxins due to an avitaminosis *B* complex may be the real factor.

Treatment of Herpes Simplex.

A PRELIMINARY report of the use of snake venom in the treatment of *herpes simplex* or *recurrens* is briefly set out, together with a report of cases, by Richard J. Kelly (*Archives of Dermatology and Syphilology*, October, 1938). The report is based on work carried out by S. M. Peck (presented before the Section on Dermatology and Syphilis of the New York Academy of Medicine in 1935) on three patients suffering from pemphigus, whose condition he assumed was the result of a virus infection. Fifteen patients suffering from *herpes simplex* have been treated during the past three years. On account of fallacious interpretation

due to the normally short duration of the disease, the author attempted to treat the condition only in the early stage of itching, burning, swelling and slight vesiculation. Careful records were kept of each patient. The following details were recorded. In twelve cases treatment was begun within from eight to twenty-four hours of the onset. Subjective symptoms disappeared from five to twelve hours after injection, and swelling and vesiculation in from twelve to thirty-six hours, the vesicles being replaced by small dry crusts only. Three other patients to whom the injection was given after twenty-four hours from the onset, stated that the subjective phenomena were noticeably lessened, although the course of the disease was otherwise unaltered. The technique of treatment consisted in the intracutaneous injection into the forearm of 0·2 cubic centimetre of moccasin snake venom in a dilution of 1 in 3,000. In one of the cases the dose was repeated in three days owing to a fresh outbreak in another area, again with excellent results. This patient was subject to recurrent attacks, which would seem to have diminished in number and severity after venom therapy. All topical applications were avoided during treatment. Further investigations were carried out on rabbits, in order to estimate the effect of the injection of venom on the artificial production of herpes. In none of the experiments was the course of the eruption modified in any way. In three cases of *herpes zoster* the sole effect of venom injection was the alleviation of subjective symptoms.

UROLOGY.

Renal Fusion.

W. F. BRASCH AND H. J. HAMMER (*British Journal of Urology*, September, 1938) review 102 cases of renal fusion diagnosed at the Mayo Clinic in eight years, with special reference to the clinical significance of the urographic data. They find that the present terminology is cumbersome, inaccurate and insufficiently descriptive; in lieu thereof they suggest that the fused kidney should be described according to its relation with the vertebral column, regardless of shape, as bilateral, prevertebral or unilateral. Inspection of a plain radiograph of the urinary tract may show any of the following suggestive features: (i) One or both renal outlines are close to or overlapping the vertebral column. (ii) The lower poles are nearer the vertebræ than the upper poles (normally the reverse is true). (iii) The lower borders of the two renal outlines may be continuous or extend over the vertebral column. (iv) There may be an indefinite mass overlying the vertebral column. (v) The renal outline is at an unusually low level. (vi) The arrangement, position and shape of any calculi present are characteristic. It is noteworthy that the shadow of the psoas muscle is not obscured by the fused kidney. Since excretory urography frequently accentuates the renal outline, a suspicion of renal fusion often becomes a certainty when the urogram is examined. One or both pelves may be observed at a lower level than normal, and they are relatively closer to the vertebral margin. The calyces of the lower segment may overlap those of the upper portion. Differential diagnosis is required from: (i) congenital single kidney with double pelvis on one side and renal agenesia on the other; (ii) bilateral incomplete rotation without fusion; (iii) normal kidney on one side with renal ectopia on the same or the opposite side. In a urogram of fused kidneys the calyces extend in the opposite direction to normal, the axis of the lower calyces is towards the isthmus, the ureter is rotated as it leaves the pelvis. The uretero-pelvic junction is either lateral or antero-lateral. Unilateral fusion occurred in about one-eighth of the cases observed by the author. The radiographic evidence differs from that found in bilateral or prevertebral fusion. The renal outline is frequently not clear, but the outline of a large mass on one side with the absence of renal outline on the other is suggestive. The shadow of the combined kidney is usually lower than that of a normal organ, and there is apparent enlargement of the hepatic outline due to ptosis. The shadow of the psoas is generally indistinct. The relation of the two pelves is of great surgical importance. In five out of thirteen cases they were so close that it was impossible to separate them.

Radiolucent Urinary Calculi.

H. KUNTSMANN (*Zeitschrift für Urologie*, May, 1938) discusses the incidence of radiolucent urinary tract calculi and various diagnostic and therapeutic difficulties associated with their presence. The author considers that when anuria is associated with blockage of only one ureter by a demonstrable calculus or other cause, and when the obvious obstructive lesion or calculus can be demonstrated on the other side, it is very likely that a radiolucent calculus or sand is obstructive on the second side. From the chemical point of view xanthin gives the poorest shadows, then pure uric acid, then uratic salts, and then cystin, the last-mentioned casting only a slight shadow. In relation to radio-opacity the total size of the stone is not so important as its chemical composition and the density of its structure, otherwise its physical architecture. Furthermore, the clarity of a stone shadow varies with the difference between the radio-opacity of the stone itself and that of the immediately surrounding tissues. Out of a total of 976 cases of urinary lithiasis studied by the author, in 148 the calculi were radiolucent, a percentage of 15. The diagnosis is difficult; but when the condition is suspected, confirmation may be gained by the use of pneumopyelography with air or oxygen, in order that the calculus by being surrounded may be shown up immediately by a medium of less density than itself. Treatment is governed by the usual principles observed in the treatment of radio-opaque calculi; but it must be remembered that radiolucent calculi have a peculiar tendency to bilaterality.

Ureteral Pain.

A SIMPLE but ingenious method has been used by N. Ockerblad and H. E. Carlson (*The Journal of Urology*, June, 1938) to map out the cutaneous distribution of painful sensations arising in the ureter. Specially constructed ureteral electrodes, graduated in centimetres, were used to stimulate the ureter at different levels. Composite charts obtained from the examination of twenty normal individuals are presented. There is considerable individual variation in the area of skin affected, but the regions are constant. These regions are those which were known to urologists in a general way from observation of patients with ureteric calculi. As so many other factors enter into the causation of pain in clinical cases, proof was lacking that specific areas were affected by painful stimuli arising at definite levels in the ureter. The author states that these areas and corresponding levels have now been charted successfully.

Grawitz Tumours.

G. NISIO (*Urologia*, March, 1938) publishes some observations on cases of renal hypernephroma pursuing an almost "silent" course. In these cases attention was first drawn to the disease by the presence of a bony metastasis, which simulated a primary tumour, and in one case resembled an aneurysmal tumour on account of the distinct pulsation. It may seem at first sight that this tendency of some hypernephromata to pursue a "silent" course for some years is a sign of benignity; but in reality the prognosis in such a type is grave, since attention may first be drawn to the disease by a metastasis. However, some hypernephromata, in spite of a progressive local spread even into veins or lymphatic glands, metastasize very late. Survival for many years has been observed after nephrectomy, even when such apparently adverse local conditions are present. Early diagnosis by bilateral retrograde pyelography is essential in all cases of hæmaturia of doubtful origin and in cases in which dull, heavy or uncomfortable sensations in the loin or side are present, which are not satisfactorily explained by other methods of diagnosis.

Congresses.

THE AUSTRALIAN AND NEW ZEALAND ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE twenty-fourth meeting of the Australian and New Zealand Association for the Advancement of Science was held in Canberra from January 11 to 18, 1939, under the presidency of Professor Ernest Scott (Melbourne).

The Sections.

The sections represented were: *A*, Mathematics, Physics, Astronomy, Optometry; *B*, Chemistry; *C*, Geology; *D*, Zoology; *E*, History; *F*, Anthropology; *G*, Economics, Statistics and Social Science; *H*, Engineering and Architecture; *I*, Medical Science and National Health; *J*, Education, Psychology and Philosophy; *K*, Agriculture and Forestry; *L*, Veterinary Science; *M*, Botany; *N*, Physiology; *O*, Pharmaceutical Science; *P*, Geography and Oceanography.

The Australian National Research Council.

Pursuant upon resolutions passed at the previous meeting of the Association at Auckland in January, 1937, certain modifications of the classification of members have been instituted. Membership is now made up of fellows, who are to be strictly limited in number and selected from distinguished members of the Association, annual members, members who join for the biennial congresses only, and associate members. The fellows resident in Australia form the Australian National Research Council.

The Australian National Research Council, which was derived from the Association some years ago, has, after a period of independent existence, now become in effect a committee of the Association. It will continue its present function as an advisory, and in some cases an executive, body in connexion with research in pure, as distinct from applied, science in Australia. In addition, the Council has commenced the publication of a journal of the type of *Nature*. This journal now appears bimonthly as *The Australian Journal of Science*. It contains scientific articles, correspondence, and notes and news with regard to scientific activities in Australia or of Australians abroad. At the annual meeting of the Council, held at Canberra on the day before the general meeting of the Australian and New Zealand Association for the Advancement of Science, the modification of the constitution made necessary by the alteration of the relation between the Council and the Association were adopted. Sir David Rivett, K.C.M.G., M.A., D.Sc., was elected President for the ensuing year.

Election of Office-Bearers.

At the meeting of the General Council of the Association, held on January 11, 1939, Dr. Patrick Marshall, Geological Consultant to the Government of New Zealand, and formerly Professor of Geology in the University of Otago, was chosen as President-Elect. It was decided to hold the next meeting at Adelaide in August, 1940. Dr. A. B. Walkom was reelected Honorary General Secretary of the Association, and the other office-bearers were elected.

The Mueller Medal.

The Mueller Medal of the Association was awarded to Professor T. Harvey Johnston, Professor of Zoology in the University of Adelaide. This medal is awarded by the Association at each meeting for published investigations of outstanding merit in the field of biology.

General Recommendations.

Among the recommendations passed at the concluding meeting of the General Council of the Association was one that a committee be appointed to cooperate with overseas bodies on the question of calendar reform. A proposal which had received considerable attention abroad was to subdivide the year into four equal quarters. A day without name or date would occur between the end of one and the beginning of the next, also between June 30 and July in leap years. The beginning of a quarter, and any given date, would always occur on the same day of the week. Each quarter would contain two months of thirty and one of thirty-one days.

Other recommendations were that the effect of various factors on the growth of population in Australian cities should be studied, and that a Commonwealth department should be instituted to undertake a complete biological survey of the Commonwealth.

Reception of Delegates.

The members of the Association were entertained by the Ministers of State of the Commonwealth at a garden party in Parliament House grounds on Wednesday, January 11. The guests were received by the Commonwealth Treasurer (Mr. Casey) and the Minister for the Interior (Mr. McEwen), representing the other ministers. A temperature of 108·5° F. was reached during the afternoon. Several of the guests collapsed and had to receive medical attention during the function, which was abruptly terminated by a brief rainstorm.

Their Excellencies the Governor-General and Lady Gowrie received the members of the Association at Government House on Friday, January 13.

The President and Mrs. Scott received the members of the Association at a conversazione on Monday, January 16. Parliament House was placed at the disposal of the Association by the Commonwealth Government for this function.

This meeting of the Association was memorable for several reasons. It marked the jubilee of the formation of the Association, it was the first meeting to be held in Canberra, and it was held during a heat wave of record intensity and duration. The meeting was attended by some twelve hundred members, and was the largest congress yet held in Canberra. The local committees are to be congratulated for the efficiency of their organization and for the smoothness with which their arrangements worked for dealing with the number of delegates, which far exceeded their first expectations.

Inaugural Meeting and Presidential Address.

The inaugural meeting was held in the Albert Hall on the evening of Wednesday, January 11. The delegates were welcomed by His Excellency the Governor-General, Patron of the Association. In his welcome, His Excellency reminded members of the two aspects of scientific progress: the acquisition of knowledge and its application to human needs. He adverted to the amazing pace at which both aspects were progressing, and emphasized particularly the resultant acceleration in transport and communication which had taken place during the previous few years. He expressed the hope that the astounding progress which was being made would be directed not to the perfection of means of destruction, but to the cause of civilization and the peace of the world.

The newly installed President then delivered his address on "The History of Australian Science". In the course of his address Professor Scott deplored the fact that the editing and publication of Australian historical records which was begun by the Commonwealth Government before the Great War, had ceased in 1925, when the period up to 1840 had been covered. He pointed out that the immediately succeeding period was one of fundamental importance in the history of Australia. He urged that it was of great importance to students that these records be made available, and that the work of publication should be resumed at the earliest possible moment. He pointed out that historical studies were by no means of purely academic interest. One aspect of these studies of vital importance to Australia was the question whether the annexation of areas, to be valid, involved effective occupation. He pointed out that England had refused to recognize the annexation of the American continents by Spain on these grounds, and that we were now in some ways in a position somewhat analogous to that of Spain. Professor

Scott then went on to describe some of the earlier scientific work which had been carried out on the then extraordinary flora and fauna of Australia. He said that in the consideration of the names of pioneer scientific workers in Australia that of Macarthur should not be forgotten. His experiments on sheep breeding had been carried out on truly scientific lines, and had been of outstanding importance in the history of Australia. He pointed to this as an early example of the fact, which the "practical man" was still slow to recognize, that there was no field of human endeavour in which science could not be of practical use to man.

Public Lectures.

During the meeting two public lectures were delivered by overseas guests of the Association.

H. G. Wells spoke on "The Role of English in the Development of a World Mind". Mr. Wells developed the thesis that in former ages war had fulfilled a necessary biological function. Its effect had been to serve as an outlet for the energies of surplus young males. Its destructive action had been largely limited to this section of the community. Its effects on other sections of the community and upon property had been comparatively minor, and areas involved had been restricted. Scientific advances had made possible the extension of belligerent operations to areas and populations formerly beyond their direct effect. All this had happened in a period so brief, from the biological point of view, that mankind had not been able to adjust itself to the changed conditions. Unless it proved capable of making the necessary adjustment with great rapidity, civilization was faced with extinction. The solution of the difficulty seemed to lie in a better understanding between different groups of mankind. The most important factor in this was a free interchange of ideas. Such an interchange would be facilitated by a common means of communication. He believed that the English-speaking peoples were best fitted to take the lead in promoting a better understanding between different peoples. One consequence of such an understanding would be a modification of the idea of sovereign states as it was now held.

Sir George Simpson (Great Britain) spoke on "Ice Ages". He explained that the earth had experienced three of these ice ages, separated by intervals of about 250 million years. He showed by means of maps the distribution of the ice sheet during these ages. He pointed out that biological, including palæontological, evidence was very unreliable as a source of information as to climate in past time. Comparison of the distribution of present-day species with that of the fossils of similar species could not be used with safety to make comparison between the distributions of climate. Interpretation of the evidence was complicated by the migration of species and their adaptability to changes of climate. Climatic conditions during an ice age showed considerable fluctuations. The age was subdivided by relatively short interglacial epochs of one to two million years. The earth at present was in one of these short interglacial epochs. The lecturer concluded by explaining that extension of the polar ice caps was not necessarily associated with a general fall of terrestrial temperature. On the contrary, a rise of temperature, by promoting evaporation at the equator, increased the accumulation of ice by condensation at the poles. Increased evaporation also protected the earth against absorption of solar heat by increasing the heat-reflecting layer of cloud in the atmosphere.

Liversidge Memorial Lecture.

The Liversidge Memorial Lecture was delivered by Professor H. G. Denham (Brisbane) on "Modern Developments in the Industrial World". The lecturer indicated how increasing knowledge of molecular structure had enabled synthetic products to be manufactured which were in some cases superior to the natural products they were replacing, and in all cases of uniform and predictable quality. He cited in particular the artificial silk industry and the manufacture of synthetic plastic materials, the use of which was extending to every branch of industry. Synthetic wool substitutes and synthetic rubber, although they had not yet displaced the natural products to the same extent, were rapidly being improved. The intensive chemical research which was being carried on in the petroleum oil industry, with the resulting improvement in motor fuels, and the advances in metallurgy which had led to the development of alloys combining lightness with strength, resistant to corrosion, or having mechanical properties far superior to the best steel, were also discussed. Finally the lecturer mentioned modern processes which had been developed for winning materials which occurred only in very low concentration in our environment. The existence of a plant capable of extracting 15,000 pounds of bromine per day from sea water, in which it was present at a concentration of only 0·0067%, was cited as an instance.

Physical Quantities.

In his presidential address to Section *A*, Professor T. Parnell (Brisbane), after traversing some of the fundamental advances in physics during the life of the Association, pointed out that the attempt to express modern physical conceptions in terms of three fundamental quantities, length, mass and time, had not been successful. Fifty years previously Kelvin had admitted his failure to explain electrical phenomena in terms of mechanical phenomena. Work in the intervening period suggested that the problem was insoluble; yet the units in general use implied that such an explanation was possible. The addition of a fourth fundamental unit concept, preferably electric charge, would lead to definite and unequivocal ideas as to the nature of physical quantities, remove ambiguities, and make classical physics a more logical and exact science.

Absolute Measurements of Ultra-Violet Radiation.

Attempts to develop a simple method for absolute measurement of ultra-violet radiation, suitable for medical purposes, were described by C. M. Focken and E. G. Edie (New Zealand). The measurements were made by exposing balanced thermopiles to the radiation transmitted through filters calibrated so that the amounts of radiant energy in the regions of wave-length 200 to 380 millimicrons in the ultra-violet could be determined. Although the measurements were not very accurate, conclusions of medical interest were claimed. The authors hoped to be able to develop a more accurate photoelectric method.

Observing and Photographing Invisible Objects.

Professor Kerr Grant, M. Iliffe and A. M. Thompson (Adelaide) described a modification of the "Schlieren" method of observing objects, such as streams of heated air, rifle bullets with their attendant wave trains, vortices in air or water *et cetera*. The principle of the method was suggested many years ago by the French physicist Foucault. Usually the sharply focused light emerging from a narrow slit was cut off by the straight edge of a screen, so that little light passed round the edge of the screen to fall upon the object screen or enter the eye or a camera. If the path of the light between the source and the straight edge was disturbed by slight variations of refractive index, due, for example, to streams of hot air or compressions of sound waves, then a far greater volume of light passed from these regions around the straight edge. This light when focused by the eye or a lens gave an image of the disturbed region, which could be seen or photographed. The modification described consisted of substituting a screen pierced with numerous holes for the slit source of light, and a photographic plate covered with opaque images of the holes for the obscuring screen with straight edge. The opaque images normally cut off almost all the light issuing from the holes. Photographs of the hot air rising from the fingers, and of streams of gas and vapour were shown.

Radio Fade-Outs and Solar Eruptions.

The results of a long series of observations of the effect of sun-spots on radio signals were described by R. G.

Giovanelli (Canberra). It had been commonly supposed that the fading of these signals was associated with the appearance of sun-spots, but the observation made at Mount Stromlo had failed to substantiate this supposition. On the other hand, there was found to be a relation between solar eruptions and the fading of radio signals. These "eruptions" consisted of sudden increases, lasting only a few minutes, of up to ten times the radiation issuing from small areas, comparable in size with the earth, on the surface of the sun.

The effect of solar eruptions on radio signals was also discussed by D. F. Martin, G. H. Munro, A. J. Higgs and S. E. Williams (Sydney). It had formerly been found that only a proportion of solar eruptions were associated with fading, and that the fading was due to the appearance of a layer of electrified air, which reflected the signals at a height of about forty miles above the earth. The observations made in Australia showed that every solar eruption produced a measurable effect on the earth's atmosphere. This effect occurred about 150 miles above the earth, and was accompanied by a reduction of the electrification of the air. It was believed that these investigations had made it possible to locate the particular band of ultra-violet radiation responsible for the fading.

A. R. Hogg referred to the observation made at Kew Observatory, which appeared to show that in England some of the electrically charged particles in the atmosphere were aggregations of molecules of sulphuric acid derived from combustion of coal or its products.

F. W. Wood (Sydney) described a method by which radio signals could be used to detect movements of only a few feet in layers of the atmosphere as high as two hundred miles above the earth. These layers were of particular importance in radio communication. The investigation should yield valuable information concerning possible tidal movements in these layers.

The Atmosphere as Raw Material.

The President of Section *B*, Mr. Russell Grimwade (Melbourne) discussed the disturbance of the balance between living organisms, especially plants and atmospheric constituents, which had occurred since the beginning of the industrial era. A marked diminution of the chlorophyllous area exposed to the air had occurred. Although this diminution had not yet reached proportions which need cause alarm, it should be remembered that plant chlorophyll was as yet by far the most important agent enabling man to obtain carbon from the air. Processes of deforestation and denudation therefore could not be viewed with equanimity from the chemical point of view. The increasing use of the rarer constituents of the atmosphere in industry was also discussed.

Symposium on Colloids.

In introducing the subject of colloids, Dr. B. W. Pennycuick (Adelaide) surveyed recent developments in colloid science, which had caused important changes in outlook. Natural fibres, such as cotton, silk, wool *et cetera*, had, he stated, been shown by X ray diffraction methods to consist of extended chains of molecules arranged in bundles known as crystallites. Molecular structure and physical properties had thus been correlated, but a final explanation, particularly in the case of rubber, was still lacking. X ray analysis had been extended with success to the study of structures such as cartilage, muscle and nerve fibres, and even to protoplasm itself. Another aspect of the development had been the large scale production of long chain molecules, giving such products as synthetic rubber, resins, lubricants and petrols. Hydrophobic colloids, being the purest and least complicated colloids, had been specially studied. Through them a better understanding of problems of the stability of colloids had been reached. Adverting to a special case, the speaker referred to work in progress in his own laboratory for the preparation of stable colloidal gold solutions suitable for the Lange test on cerebro-spinal fluid.

Dr. E. Heymann and A. R. Docking (Melbourne) discussed the lyotropic series of ions in relation to the adsorption of salts on gelatine. They pointed out that, as was well known, many of the properties of colloids, in particular their stability in solution, were influenced by salts. Ions fell into a definite series with respect to this effect. It had been suggested that the action was due to competition between the ions and the colloid for water, a solidifying influence (salting out). A varying degree of adsorption of the hydrated ions on the colloidal particles increased their solubility and exercised a liquefying influence. The first effect would predominate with ions at the beginning of the lyotropic series, the second with those at the end. The effectiveness of sulphates and of magnesium salts as protein precipitants (extremes of the negative and positive series of ions), for example, was well known.

Professor E. J. Hartung and G. M. Willis (Melbourne) submitted a paper on diffusion problems in membranes. The necessity for taking into account effects due to the osmotic movement of the solvent, flow due to hydrostatic pressure, electrical charges on the particles, and other effects on the diffusion through a membrane of substances in solution was emphasized. The parts played by sieving action, adsorption on the membrane, and the charge on the membrane were indicated. These gave different effects on different assumptions. The role of adsorption in particular was one requiring further study. A new apparatus for the measurement of rate of diffusion through membranes without the introduction of effects due to changes of concentration of the substance studied was described.

The sol-gel transformation of colloids was discussed by Dr. E. Heymann (Melbourne). The main types of transformation were: (i) Isothermal, in which reversible transformation occurred merely on shaking the solution. It was by means of this property that living colloids, which were in a state (thixotropic) having little stability, could be penetrated by a solid body without apparent damage. Liquefaction occurred before the moving object and gelatin behind it. An example quoted was the passage of a nematode through a muscle fibre. (ii) Non-isothermal, in which reversible transformation occurred either on cooling (gelatine, agar) or on warming (methyl cellulose). Measurements of electric conductivity and of dielectric polarization showed that no honeycomb structure existed in the jelly and that practically the whole of the water present was in the free state. Measurements of volume changes showed that hydration of a colloid might either increase or decrease during gelation. Some colloids gave two types of gel: a clear jelly or an opaque curd. In the curd the particle consisted of interlacing fibrous crystals; in the clear jelly the particles were roughly spherical.

The Relation between Chemical Constitution and Biological Activity.

A joint discussion on the relation between chemical constitution and biological activity was held by Sections *B*, *I*, *N* and *O*.

The discussion was opened by Dr. V. M. Trikojus (Sydney), who spoke on chemical constitution with particular reference to substances affecting the basal metabolic rate. In some instances physiological action was associated with marked specificity of structure (for example, vitamin *C*, acetyl choline); in others a wide variety of substances appeared to have comparable action (for example, œstrogenic substances). Many substances affected the basal metabolic rate (for example, nitrophenols, adrenaline, cocaine), but thyroxin and allied substances had in addition certain specific properties. Replacement of the iodine in these compounds by other halogens modified their properties quantitatively only. Diminution of the number of halogen atoms in the molecule diminished its activity. Diiodothyronine was less active than thyroxin, and thyronine without action. Contrary to previous findings, Dr. Trikojus and his colleagues had observed that removal of the carboxyl group from thyroxin left a compound (thyroxamine) which still increased oxygen consumption in guinea-pigs. Methylation of the phenolic group did not diminish its potency. The essential groups of the thyroxin molecule appeared to be the halogen atoms, the diphenyl ether linkage and the amino group.

Virus Activity as a Property of Some Protein Molecules.

After a short introduction, R. J. Best (Adelaide) described his recent work which had resulted in the separation of certain viruses in a chemically pure state and had demonstrated that they were proteins. Evidence for the identity of the protein and the infective principle in the case of certain plant viruses was presented. Some aspects of the gross physical structure of the virus as revealed by X ray analysis and optical means were described. After mention of a few of the properties of viruses most likely to have a bearing on biological activity, problems relating to strain variation, mutation and possible methods by which viruses multiply were touched on. The virus molecules built themselves into long chains, quite readily visible under the microscope in polarized light. These chains were readily broken up mechanically, but on standing they formed again. All the virus proteins so far examined contained nucleic acid.

Dr. A. Albert (Sydney) spoke on the chemotherapy of the acridine derivatives. A good deal of attention had been directed to this group of substances as a result of the success which had attended the therapeutic use of flavine and related compounds. The efficiency of flavine in the treatment of infected deep wounds had been established during the Great War. Proflavine had since been shown to have the same antiseptic activity, with one-fourth its toxicity. After mentioning some of the more complex acridine derivatives, Dr. Albert mentioned the investigations of himself and colleagues on 2;7-diaminoacridine. This had been shown to have the same antiseptic power as proflavine, but only two-fifths of its toxicity. The chloroacridines seemed promising also and were being further investigated.

In the discussion which followed, Sir David Rivett pointed out the analogy which existed between virus-host systems and a relatively simple three-component system, such as salt-water-soap. He stressed the difficulty of determining the equilibrium conditions even for such a simple system.

H. Marston (Adelaide) said that the association of viruses with crystals went back thirty years. Definite crystalline inclusions had been found in infected cells. These had been found to be calcium phosphate crystals with which the virus was associated. He doubted whether the purified virus proteins could be regarded as crystals, as they were only two dimensional, whereas true crystals were characterized by definite angles between faces in three planes. He pointed out that the infectivity of the virus preparation decreased as the size of the so-called crystal increased. The most infective material was expressed cell sap, which contained only very short virus fibres. The multiplication of virus could not be considered apart from its association with the host. It was built upon the cell mosaic of the host cell.

Professor W. J. Young (Melbourne) doubted whether the increase of virus protein in infected cells could be regarded as a multiplication of these protein molecules. It might be considered that the virus modified the metabolism of the cell in such a way that some virus protein was produced by it in place of its normal protein.

Dr. R. Lemberg (Sydney) expressed a somewhat similar view and suggested that the virus might be regarded as a proteolytic enzyme, which, acting on the cell proteins as substrate, produced from them virus protein as one of the products of its action.

A brief review of the present state of knowledge of the relation of chemical constitution to biological activity was given by Professor H. W. Davies (Sydney).

Dr. S. Dattilo-Rubbo (Melbourne) pointed out that biological activity was obviously a result of a reaction between the compound in question and the cells of the organism on which it acted. The chemical constitution of the latter was just as important a factor in the reaction as that of the former. He instanced the differing toxicity of the same compound on different organisms.

Professor N. V. Sidgwick (Oxford), speaking to the general question of chemical constitution and biological activity, said that modification of chemical structure might not only affect directly the action of a compound on a cell, but might also alter the distribution or the concentration of the compound on the active areas of the cell. The question of the effective concentration in the cell of the substance being studied was of fundamental importance, but there was almost no information about it.

Resonance.

Professor N. V. Sidgwick (Oxford) explained that when one atom or group of a molecule could occupy more than one position, a number of isomeric compounds were possible. The isomers were chemically distinct substances capable of separate or simultaneous existence. When, however, the alternative possible positions of the transferrable atom were very close together in the molecule, a totally different kind of isomerism was produced. The atom in question then occupied neither of its possible positions, but an intermediate position. It did not vibrate between the two possible positions. To this phenomenon the name of resonance had been given. It explained some previously anomalous energy relations of molecules capable of this kind of change. While the energy content of the molecule with the movable atom in one position altered only very little when the atom moved to the other position, it was definitely less with the atom in the intermediate position. The resonance compound was therefore the most stable of the three in question, and always formed when possible.

The advantage of the conception of resonance in rendering unnecessary certain complex but ill-founded hypotheses of electronic configuration in the molecule was emphasized by Dr. R. Lemberg. He stressed the great importance as biological catalysts of substances with resonance structure. The combination of a resonance structure with a complexly bound metal atom, as in the blood pigments and cytochrome, seemed to be of special biological significance. The conception might make possible a physical explanation of the peculiar catalytic activity of such compounds.

The Chemistry of Hæmoglobin Metabolism.

In discussing the chemistry of hæmoglobin metabolism Dr. R. Lemberg (Sydney) said that it had hitherto been assumed that hæmatin and porphyrin were intermediate products in the change from hæmoglobin to bile pigments, the removal of protein being followed by that of iron, and the porphyrin transformed into bilirubin. It could now be shown that the real intermediate products were bile pigment-hæmatin compounds and biliverdin, the oxidative opening of the porphyrin ring occurring before the removal of protein and iron. The reaction began with the hydrogenation of oxyhæmoglobin. Among the intermediate compounds were those with "easily detachable iron". Finally, biliverdin was reduced by dehydrogenase systems to bilirubin. In the intestine bilirubin was reduced to urobilin. The iron from the bile pigment-hæmatin compounds was used for the synthesis of hæmoglobin, but nothing was known about the synthesis of the porphyrin ring in the animal body. In different circumstances oxidation might occur at the side chains and not on the porphyrin nucleus. Under these conditions biologically important catalysts, such as the cytochromes, might be formed.

Physical Education in Relation to National Fitness.

In his presidential address to Section *I*, Dr. E. Sydney Morris, Director-General of Public Health in New South Wales, said that although the average Australian compared favourably in physique with the average individual of other countries, he fell short of what was possible considering his natural advantages. That Australians could not be regarded as an outstandingly fit nation was shown by the number of persons treated in public, private and mental hospitals and by the number of invalid

pensioners. Under modern conditions of life physical activities were subordinated to intellectual functions. It was necessary to establish equilibrium between mental and physical effort. While universal State education was established as a right, and its acceptance was enforced by law, the provision of opportunities for the maintenance of physical health was left very largely to the individual. Provision was necessary for the needs of three groups: pre-school and school children, adolescents and adults. The modern conception of physical education visualized man not as an entity of so many muscles, but as a human being with a mind and soul as well as a body. Any organization set up should be flexible enough to conform to the changes inseparable from progressive development. The cooperation of public authorities and citizens generally was necessary if adequate facilities were to be made available. Effective medical supervision was necessary to protect under-nourished or otherwise handicapped children against unsuitable exercises. To make any organization generally effective full advantage would have to be taken of the Press, broadcasting and other means of publicity for the dissemination of propaganda among as large a number of people as possible. Organization of leisure time so that the advantages of physical education could compete with commercial forms of entertainment would be necessary for success.

Child Development and Facilities for Education in Nursery Schools.

Miss C. M. Heinig (Melbourne) discussed the importance of assuring the symmetrical physical and psychological development of children during the critical period from two to six years of age. She showed the very simple and inexpensive type of equipment or toys, the use of which would develop the self-reliance of the child. Furniture or toys of unsuitable design or dimensions contributed to bad posture habits. The toys with which the child played should be of such size that their handling and arrangement presented problems. Occasional hints but no systematic help should be given by adults towards their solution. Their use should be attended by certain minor risks. By these the child's courage and caution were given opportunity to develop normally. The use of communal toys gave children experience in solving minor social problems. Occasional tantrums should be regarded as a normal feature of this period.

The Diet of Australian Schoolboys.

Dr. H. S. Halcro Wardlaw (Sydney) presented the results of the examination of the food of a number of great public school boys over a period of a week. The constituents of the food fell into two groups when correlated with the age and size of the boys. The consumption of building materials (protein, mineral substances) increased with the weight. Fuel consumption (carbohydrate, fat) increased more slowly and kept pace with increase of surface area. The figures suggested a relation between total energy consumption and area similar to that between basal requirement and area. When expressed in "man units" the group had an average daily consumption of 2,600 calories, 95 grammes of protein, 100 grammes of fat, 352 grammes of carbohydrate, and 19 grammes of mineral matter. The boys of the group were definitely taller and heavier than comparable State school boys, but were very similar to a comparable group of English boys. The English boys had a net energy consumption about 10% greater. This difference was readily accounted for by difference of climate. The boys consumed a diet richer in fat during the cooler months of the year, but the total calorific value was not increased.

The Maximum Power of Human Work.

Champion cyclists were found by Dr. F. S. Cotton (Sydney) to be able to work for five-minute periods at rates over half a horse-power. These figures were materially higher than the highest recorded figures for this period of work, namely, those of Olympic oarsmen, in spite of the fact that the latter figures included a somewhat arbitrary allowance for work not used for propelling the boat. The possibility that the more rapid muscular contractions of the cyclist were more efficient and that respiratory exchange was not restricted by fixation of the muscles of the chest wall were discussed. The fallacies of measurements of respiratory exchange starting from and returning to a state of rest rather than a known moderate rate of working were mentioned.

Heart Size in Relation to Physical Exercises.

Dr. F. Duras (Melbourne) discussed the results he had obtained from the measurement of heart size after various types and intensities of exercise. Measurements were made of the lateral diameter on the fluoroscopic screen. The size of the normal heart showed a high correlation with age, height and chest circumference. Heart size decreased during static work, increased during moderate dynamic work, and increased only slightly, if at all, during more strenuous work. After exercise the size of the heart fluctuated about a continually increasing mean size. It might not return to the pre-exercise measurement for forty-eight hours. The possibility of complete relaxation of heart muscle being prevented by fatigue was considered. The resistance of the heart to exercise was diminished by infectious disease, even minor ailments, by malnutrition and even by mental or emotional states. The normal heart could not be damaged even by the most strenuous exercise, but the normality must be established by proper medical examination.

Physical Education and National Health.

Dr. Duras also submitted a long paper on the various aspects of physical education as a means to national health. In it he stressed the importance of arousing the interest of the individual. He pointed out that physical fitness implied something much wider than fitness for games or exercises. It should be approached through central research institutes, where the effects of various kinds of exercise on different representative types could be studied. With this should be associated the training of teachers, who would be responsible for the third stage of the process, the application to the community of the results obtained. The active cooperation of the medical profession was essential to any scheme because of the central part played by medical examination and supervision.

Medical and Physical Surveys of School Children in New South Wales.

The results of his survey of over 16,000 New South Wales school children were presented by Dr. A. E. Machin (Sydney). Of the boys examined, 34·2% had uneven or dropped shoulders. While the carrying of the schoolbag in the hand was undoubtedly a factor in producing this condition, one-handed games, such as tennis, were also responsible to some extent. Deformities of the feet, especially in girls, were often the result of ill-fitting footwear. Of the children examined, 77% had no or only negligible medical defects; 20·5% had remediable, including dental, defects; 1·9% had permanent but not seriously incapacitating defects; permanent serious incapacity occurred in 0·4%. Posture was good in 26% and below the average in 26%. Nutrition was good in 37% and below the average in 8·3%; it was poor in 2·1%. There was, however, a definite improvement on the average heights and weights observed in 1918.

In the discussion on the paper Professor Harvey Sutton said that the evidence of occurrence of postural and especially spinal defect indicated a failure, from the physical point of view, of our educational system in immobilizing children for long periods at desks. Their postural needs were completely neglected. The occurrence of so many preventible foot deformities was also a serious reflection on the manner in which footwear was selected for children.

Nutritional Factors as Causal Agents in Disease.

In discussing nutritional factors as causal agents in disease, H. R. Marston said that from earliest times the

association between famines and epidemics had been attributed to increased susceptibility to disease resulting from nutritional stress. It had since been shown that certain maladies were due to lack of inorganic constituents or organic complexes. The mere occurrence of a particular substance in the body did not indicate that it was necessary. It might be accumulated as a result of detoxicating action. The necessity for certain elements and compounds, present only in traces, had, however, been established beyond doubt. The range of substance required depended on the organism. The necessity of copper, cobalt, zinc, boron, manganese and other elements for ruminants was referred to. The vitamins were examples of organic compounds needed only in traces. It was now becoming evident that the substances required in traces owed their importance to the essential parts which they formed of certain enzyme systems.

Virus Diseases.

A joint discussion of virus diseases was held by Sections *I*, *K*, *M* and *N*. In initiating the discussion Dr. B. T. Dickson (Canberra) referred to the large number of biological species which were affected by virus disease. In the economic field these diseases caused enormous annual losses of domestic animals and plants. From recent work on cross-inoculation and serological studies it was becoming evident that a group of viruses was possible in many cases. The controversy as to whether viruses were to be considered living organisms or not was referred to. The isolation in 1935 of a crystalline protein having all the properties of a virus marked a definite stage in the controversy. Virus particles had been obtained which were actually smaller than some protein molecules. While it had not yet been shown that virus properties were not due to some impurity of the protein crystals obtained, this now seemed very unlikely. There seemed to be some hope that by inoculation with mild strains plant stocks resistant to virulent strains could be developed.

Dr. J. G. Bald pointed out that because viruses could multiply but did not respire or independently metabolize, they might possibly be regarded as intermediate links between the living and the non-living. Within the cell virus molecules multiplied with the speed of chemical reactions in an environment very different from that of their antecedent molecules, if they could be regarded as having evolved. Such antecedent molecules might exist today, but they had to be discovered before the development of living from non-living matter could be considered. Viruses might, of course, be a degradation of more complex forms. A speculative picture of the virus molecules in the host cell could be based on present knowledge of the protein molecule. In some cases active centres were more effectively hidden within the molecule than in others. When the virus protein was spread on the lipoid interfaces of the host cell the active centres were exposed and could react selectively with the protein of the cell, building up virus protein. Varying cell organization limited viruses to certain hosts and modified the development within the hosts.

Most veterinarians, according to T. S. Gregory (Sydney) regarded viruses as living entities. The present difficulties of culturing might eventually be overcome, as had been the case with Johne's bacillus. Bovine pleuropneumonia had been considered to be caused by a virus, but the supposed virus had been shown to be culturable, particulate and yet tissue specific, so was now regarded as a bacterial organism. Morphological studies had revealed not only long filaments, but also small elements which explained its filterability. The organism showed great similarity to a true virus. With many bacterial diseases satisfactory immunization could be obtained only by inoculation of the living organism with an immune serum, a method commonly used with viruses. These and many other examples indicated the great similarity between viruses and living organisms.

Dr. F. M. Burnet (Melbourne) said that with the present definition of viruses as particulate agents of disease smaller than bacteria and capable of being grown only on living cells of a host, it was difficult to believe that there were any natural biological divisions between the micro-organisms of disease. Certain strictly parasitic bacteria could not be grown apart from living cells, whilst among the larger "true" viruses were many features of resemblance to bacteria. The nature of viruses could be examined from three points of view. Complete physicochemical formulation of even the simplest virus was never likely to be attained. A pragmatic approach could be made by seeking the working hypothesis best suited to the practical needs of the virus, the research worker, the clinician and the veterinary or plant pathologist. The third approach to the problem was the evolutionary one. Here there were three possibilities: the virus was a pathologically active fragment of the cell it parasitized; it represented a surviving form of a precellular stage of evolution; or it was a specialized or degenerate descendant of a larger parasitic microorganism. The third hypothesis seemed most likely to be true. It provided an explanation of the graded series from bacteria to the smallest viruses. It was well known that the more highly parasitic bacteria were harder to grow *in vitro*, produced more specific types of disease, and showed a greater tendency to intracellular growth. The rickettsias were almost certainly derived from bacteria which had developed a symbiotic habit in arthropods. With development of complete parasitism viruses had lost to a greater or less extent their complement of enzymes and now made use of the enzymes and activated molecules of the host cell. The types of virus now in existence represented various stages in the process of parasitic degeneration.

The influence of recent developments on the control of plant viruses was discussed by R. J. Best (Melbourne). A brief summary was given of the recent work, showing that many plant viruses and at least one animal virus were proteins; that protective immunization was conferred by infection with mild strains, and that the interspecific transfer of genes determined necrotic response to infections. Viruses being a group of living molecules intermediate between the macromolecules of the chemists and the micro-organisms of the biologists, much cooperative investigation from the physical, chemical and biological sides was required to elucidate their nature.

Miss D. Lush discussed the tissue specificity of the influenza virus. Many viruses, of which the influenza virus was a good example, were rather strictly limited to one particular tissue, in this case the lining of the respiratory tract. This tissue limitation was also shown when the virus was grown on embryonic organs. Influenza virus grew best in the lung of chick and guinea-pig embryos, although innocuous to the adults of these species. The more embryonic the tissue, the wider the range of organs which would allow growth. Studies of this kind might throw light on the nature of the interaction between virus and susceptible cell.

Dr. I. M. McKerras (Canberra) suggested that the biological origin of viruses might be multiple, and that some might be degenerate descendants of protozoa rather than of bacteria. Evidence that virus was present only at certain stages of the life history of some organisms also pointed to a biological origin.

Professor H. Priestley (Sydney) pointed out that degradation of species in the direction of decrease of size must lead to diminution of the number of chemical groups present in the organism. Such an organism might, for example, become dependent on its host for some of the enzymes required in its metabolism, for certain amino-acids, or even for simpler compounds.

Professor W. J. Young (Melbourne) agreed with this point of view. He found it difficult to conceive of proteins reproducing themselves, but could imagine the host reproducing the pattern of the invading virus protein. The need to study the virus with the host cell and not as a particulate unit was emphasized.

Dr. S. Dattilo-Rubbo (Melbourne) suggested that through enzyme action all life was parasitic, and that because of host, or even particular host cell specificity, virus parasitism could not be easily explained by chemical synthesis.

In referring to the semi-crystalline or crystallite nature of virus protein, F. H. Holden remarked on the possibility of determining birefringence *et cetera* in suitable suspensions of minute organisms.

Professor Prescott referred to the progressive simplification which must accompany decrease of size.

In summarising the discussion, Dr. B. T. Dickson (Canberra) said that during the twenty-five years for which he had been interested in viruses, the theories as to their origin and nature had ranged over most possibilities, enzymatic, protozoan, bacterial, mycoplasmic, wild genes, and so on. It was evident that scientists could not say whether viruses were living or not, because the answer to the question depended on the definition of what was living. The conclusions seemed inescapable that some viruses were nucleoprotein. He recommended those interested in light literature on viruses to read P. F. Clark's "Alice in Virusland", published in the *Journal of Bacteriology* in 1938.

The Effect of Fire on Vegetation.

In a paper, rather apposite in view of the conditions prevailing during the meeting, N. C. W. Beadle (Sydney) gave an account of observations on Hawkesbury sandstone areas. The damage by fire was restricted to the aerial portions of plants. Shrubs and herbs were usually destroyed. Trees escaped with defoliation. Underground organs and well insulated stems survived. Measurements of the soil temperatures at different depths during a fire had been made by burying a number of substances of known melting points. The temperature effect of the fire was found to extend only a few inches below the surface. The factors involved in the replacement of plant communities in burnt areas were discussed.

The Protein Molecule.

In his presidential address to Section *N*, Professor W. J. Young (Melbourne) gave an account of recent developments in knowledge of the structure of the protein molecule. It now appeared that even though proteins varied in the chemical units which they contained, there was a general uniformity of the plan on which the amino-acids were arranged. These were combined in chains in a regularly recurring order. In some proteins (fibrous proteins, such as silk, wool) the chains remained open, or folded only to a minor extent. In others, the majority of proteins, the folding led to the formation of closed rings arranged in a definite pattern, the unit of which was the so-called "cyclol 6" structure. In this way networks rather than fibres were formed. The networks were not open and flat, but enclosed space, and presented a more or less spherical surface. There might be several of these surfaces arranged concentrically as a "case colony". Different proteins, while similar in general plan, differed in the nature of the side chains projecting from the main chain or network. By means of these the protein unit reacted with each other to form more complex structures, or with other compounds. Physical, and particularly ultracentrifugal, studies had shown that the fundamental protein unit had a molecular weight of 17,600 and occurred in multiples of this. Molecular weight ranging from 17,600 to 17,000,000 had been observed, the higher figure being that of some virus proteins. The larger aggregrations readily dissociated into fractions on variation of the pH.

Symposium on Animal Pigments.

In introducing a symposium on animal pigments Dr. R. Lemberg (Sydney) pointed out that although a few were ornamental or had functions associated with vision, the majority of these pigments did not owe their biological importance to their colour. Certain features underlay their chemical constitution and their absorption of visible light. Their colour was due to the presence of metal ions of variable valency, such as those of iron or copper, or to conjugated double bond systems with resonance. The resonance structure explained the complex combinations of porphyrins with metals, and perhaps explained the ability of some of these pigments to act as hydrogen carriers in cell respiration. Many biologically active pigments contained a coloured active group combined with a specific protein.

The physiological disintegration of hæmoglobin in the animal body was discussed by W. H. Lockwood. The evidence for the formation of intermediate bile-pigment-iron-protein by oxidation of the α-methene bridge of the porphyrin molecule of hæmoglobin was presented. With choleglobin, the best known of these compounds, reversible combination with oxygen and carbon monoxide could be observed spectroscopically. By action of ascorbic acid on hæmoglobin in air a second similar compound was formed. Both compounds occurred in normal erythrocytes and were formed when blood containing dissolved hæmoglobin was perfused through the spleen or after *in vivo* hæmolysis by the action of distilled water, arsine, or phenylhydrazine. From these intermediate compounds removal of iron and protein gave biliverdin. Body dehydrogenases could reduce this to bilirubin.

Cytochrome *a* and the respiratory ferment were discussed by W. H. Lockwood (Sydney). These respiratory catalysts most frequently occurred as a mixture of pigments, cytochromes *a*, *b* and *c*. Their absorption spectra were described. The identity of the hæmatins from the mixture known as cytochrome *a* was considered. The coupled oxidation of pyridine protohæmochromogen with glutathione, copper-free cysteine or thioglycollic acid produced hæmatin compounds of this type.

H. F. Holden (Melbourne) pointed out that although the amino-acids which make up the protein portion of blood pigment had been determined, no substance with its peculiar property of transporting oxygen had been made. The essential features of the protein which conferred this special property were still unknown.

Dr. J. S. Anderson (Melbourne) referred to the importance of measurements of magnetic moments in elucidating the structure of these complex metal-organic pigments. By means of these measurements it was now possible to determine hæmoglobin concentration as accurately as by gasometric measurements of oxygen content.

Tissue Injury by Radiant Energy.

In a paper on tissue injury by radiant energy Dr. C. H. Kellaway and Dr. E. R. Trethewie (Melbourne) gave an account of recent experiments carried out at the Walter and Eliza Hall Institute, Melbourne. Injury by radiation caused the isolated lung preparation to liberate histamine in a manner similar to a number of pharmacologically active substances (venoms, peptone *et cetera*). In the dog's lung an output of 0·2γ to 0·4γ per minute was caused. The injurious effect of light on tissues sensitized by dyes was not confined to regions normally exposed to radiation. It was also found that histamine was destroyed by photodynamic action in the presence of oxygen. In suspensions of ground lung tissue, for example, the histamine content disappeared on exposure to light. The response to histamine of an isolated jejunum preparation of a guinea-pig sensitized with hæmatoporphyrin protoporphyrins rapidly diminished on exposure to light. Methylene blue caused increased sensitivity of the gut to histamine in the dark; in bright illumination the effect rapidly diminished. Eosin elicited the slow contracting effect on the gut, which in bright illumination failed to relax readily following histamine contractions. The injury to muscle cells in these experiments was such that they failed to respond to the histamine which was almost certainly set free and which might also have been destroyed by photodynamic action.

The Response of Marsupials to Sex Hormones.

Dr. A. Bolliger and A. L. Carrodus (Sydney) described the results of injection of female opossums (*Trichosurus vulpecula*) with male sex hormone (testosterone) and of

males with female hormone (œstrodiol). Gross changes were noted around the pouch, scrotum and cloaca, particularly in young animals. In the young male injections started at the age of five months produced testicular ascent and inversion of the scrotum. After three months longitudinal folds became evident on either side of the scrotal remnant. In a fully grown but not sexually mature male atrophy of the penis and Cowper's glands was found in addition. The males eventually died of renal insufficiency due to prostatic obstruction. Precarcinematous changes were observed in the prostate. Females tolerated large doses of testosterone. Hypertrophy of the clitoris was produced. The mammary glands enlarged and a septum appeared between them. The analogies between cremasteric muscle and the *compressor mammæ* in the scroto-marsupial area and between the *sphincter marsupii* and the scrotal muscle were pointed out.

British Medical Association News.

NOMINATIONS AND ELECTIONS.

THE undermentioned has applied for election as a member of the New South Wales Branch of the British Medical Association:

Pearson, Alva Thomas, M.B., B.S., 1938 (Univ. Sydney), 20, Paton Street, Kingsford.

The undermentioned has been elected a member of the South Australian Branch of the British Medical Association:

Wilson, Robert Kevin, M.B., B.S., 1937 (Univ. Adelaide), Renmark Avenue, Renmark.

The undermentioned have been elected members of the Victorian Branch of the British Medical Association:

Biddle, Deryck Jordon, M.B., B.S., 1938 (Univ. Melbourne), Prince Henry's Hospital, St. Kilda Road, Melbourne.
Donald, Charles Douglas, M.B., B.S., 1933 (Univ. Melbourne), F.R.C.S., 61, Collins Street, Melbourne.
Duffy, Donald Grant, M.B., B.S., 1938 (Univ. Melbourne), Alfred Hospital, Prahran.
Edwards, Robert Keith, M.B., B.S., 1938 (Univ. Melbourne), Alfred Hospital, Prahran.
Hodge, Robert Leonard, M.B., B.S., 1938 (Univ. Melbourne), Royal Melbourne Hospital.
Hudson, Leslie Charles, M.B., B.S., 1934 (Univ. Melbourne), P.O. Box 93, Quambatook.
Maclean, Roderick Euan George, M.B., B.S., 1938 Univ. Melbourne), Geelong Hospital, Geelong.
Mendelsohn, Albert Clive, M.B., B.S., 1938 (Univ. Melbourne), 11, Charnwood Road, St. Kilda.
Parsons, Peter James, M.B., B.S., 1938 (Univ. Melbourne), Royal Melbourne Hospital, Melbourne.
Patrick, Thomas Buchanan Campbell, M.B., B.S., 1938 (Univ. Melbourne), Base Hospital, Mooroopna.
Prendergast, Francis Michael Gerald, M.B., B.S., 1934 (Univ. Melbourne), D.P.M., Mental Hospital, Ballarat.
Refshauge, William Dudley, M.B., B.S., 1938 (Univ. Melbourne), Alfred Hospital, Prahran.
Roberts, Edgar Lennard, M.B., B.S., 1937 (Univ. Melbourne), Australia House, The Strand, London.
Stawell, John Richard, M.B., B.S., 1938 (Univ. Melbourne), Royal Melbourne Hospital, Melbourne.
Thomas, Lena Amy Lysbeth, M.B., B.S., 1937 (Univ. Melbourne), 5, Westley Avenue, Ivanhoe.
Waddell, Robert William, M.B., B.S., 1938 (Univ. Melbourne), 20, Roslyn Street, Brighton Beach.

Post-Graduate Work.

WEEK-END COURSE IN SURGERY.

THE New South Wales Post-Graduate Committee in Medicine announces that a course of instruction in surgery will be held at the Prince Henry Hospital, Little Bay, during the week-end May 13 and 14, 1939. The programme is as follows:

Saturday, May 13.

9.30 a.m.—Clinico-pathological demonstration: "Carcinoma of the Colon." The Director of Post-Graduate Surgery.
10.30 a.m.—"Spinal Analgesia." Dr. W. I. T. Hotten.
11 a.m.—Morning tea.
11.15 a.m.—"Indications for Radium Therapy." Dr. H. J. Ham.
12 noon.—"The Sulphonamides." The Director of Post-Graduate Medicine.
1 p.m.—Luncheon.
2 p.m.—"The Acute Gynæcological Abdomen." Dr. Reg. Davies.
3 p.m.—"The Diagnosis and Treatment of Pyelitis." Dr. R. J. Silverton.
4 p.m.—Afternoon tea.
4.15 p.m.—"Fractures of the Shaft and Lower End of the Humerus." Dr. W. Vickers.
5 p.m.—"The Classification and Symptomatology of Cerebral Tumours." Dr. Rex Money.

Sunday, May 14.

9.30 a.m.—"Indications for and Technique of Cholecystectomy." The Director of Post-Graduate Surgery.
10.30 a.m.—"Premedication in Surgery." Dr. H. J. Daly.
11 a.m.—Morning tea.
11.15 a.m.—"Treatment of Varicose Veins." Dr. V. M. Coppleson.
12 noon.—"Streptococci in Surgery." Professor H. K. Ward.

A second week-end course in Surgery will be held at the Prince Henry Hospital during the week-end August 5 and 6, 1939; a programme will be published later.

The fee for either of these courses will be £1 1s. Applications for registration, which must be accompanied by a remittance for the amount of the fee, must be made to the Secretary, New South Wales Post-Graduate Committee in Medicine, the Prince Henry Hospital, Little Bay.

Obituary.

KEITH MOORE WHITING.

DR. KEITH MOORE WHITING, whose death has already been recorded in these pages, was born at Randwick, New South Wales, on June 5, 1882. He first went to school at Miss McCauley's School, Darling Point, and then to Sydney Grammar School. From here he passed to the University of Sydney, where he entered the Faculty of Arts. At the end of the first year he transferred his studies to the Faculty of Medicine. He was a successful student and graduated in 1909. Throughout his student days he took an active part in sport, winning his "blue" for rowing and tennis. He took part in boxing contests and also held a commission in the Sydney University Scouts. After graduation he became resident medical officer at Toowoomba General Hospital, Queensland, where he laid the foundation of his surgical knowledge and began to acquire the skill

which was later on to make him a competent and reliable surgeon. In 1911 he began practice in Parramatta.

Shortly after the outbreak of the Great War, Whiting offered himself for service. He left Australia as a captain in the Australian Army Medical Corps. His first post was at Number 11 British Stationary Hospital, Rouen, and he went later to the Thirteenth Field Ambulance, the Fourth Pioneer Battalion, and the Twelfth Field Ambulance. He returned to Australia in April, 1919, with the rank of major. He represented Australia at the Allied tennis tournament in Paris, and he was mentioned in dispatches.

The personal tributes from his friends, published herewith, show what manner of man he was, and bear witness to his worth and his straightforward honesty. He lived a full and useful, though a comparatively short, life. He made many friends, both in the medical profession and outside its ranks, and was one of a type that Australia can ill afford to lose.

Dr. K. S. MacArthur Brown writes:

So happy have always been the relations existing between my own household and that of my late colleague that the totally unexpected news of his sudden passing came as a staggering blow to us all.

Keith Moore Whiting was by some years my senior—although I could never think of him as anything but a contemporary — so that he had already entered private practice at Parramatta whilst I was still a raw student. My earliest impression of him goes back to those days when he would pass me in the corridor of the medical school and would greet me with that friendly smile which all his patients learnt to cherish as the years went by. It seemed to me that he was always busy hunting for something, most likely in pursuit of fresh knowledge; and that sort of keenness meant that he must be building up his practice upon a fairly firm foundation. My interest in him at that time was no doubt stimulated because of the fact that he was then practising in opposition to my father, who spoke of him as "a nice fellow and straight in all his dealings". This was high praise indeed for one of the old school to bestow upon a young man who had the temerity to set up his plate in the same street.

Not long after our return from the World War I soon realized that my senior colleague, Keith Whiting, was serious opposition for a young struggling practitioner to face. But the knowledge that he had served as a medical officer with front-line units (I have only learnt today that he was mentioned in dispatches) made one conscious of a spiritual bond between us, so that professional jealousies could not arise. As time went on we played golf together, had many hard sets of tennis together, and I accompanied him on some of his fishing expeditions. In all these pleasant pastimes he was immeasurably my superior; but he spared me any discomfort by making me feel that at least I was companionable. He was equally successful at bowls and, above all, at billiards; but the friendly spirit prevailed on all occasions, however hard the contest.

Some of my happiest recollections are of the times we spent together at Palm Beach. His ideal of perfect bliss was to have a few kindred spirits aboard his 45-foot launch (specially designed to serve his passion for deep-sea fishing), cook all the meals for his guests, rouse them from their slumbers before daylight, and then cruise out to the fishing grounds fifteen miles due east of Broken Bay. Returning home to Parramatta after a long and tiring day, he would occupy himself for most of the evening in the distribution of large parcels of snapper and bream amongst his many friends in the neighbourhood. In recent years he made excursions to the Great Barrier Reef to experience some of the thrills of big-game fishing off Hayman's Island. In these delightful surroundings his keen appreciation of the beauties and wonders of Nature helped to fill every minute of the day with rapturous interest and enjoyment.

The comparatively short career of Keith Moore Whiting is crowded with the record of faithful endeavour and bold achievement. A well-balanced coordination between head, heart and hand helped towards his success in so many spheres of practical activity. He had been blessed with a mother who never lost an opportunity to encourage him in anything worth while; so that the manual training derived from the carpenter's workshop provided by his parent may have stood him in good stead when he came to tackle major surgery in his resident days at Toowoomba Hospital. At all events he made himself extremely competent as a general surgeon. We freely acknowledged his prowess as a skilful and careful operator, calling him to our assistance in many a difficult case.

Although Keith Whiting studiously avoided public life, simply because it had no appeal for him, his citizenship nevertheless was of inestimable value to our community. In this regard probably his greatest achievement was the building up of a splendid home life; there reigned peace, harmony and contentment. Fortunately the medical tradition is already being carried on by Dr. Terence Whiting, his eldest son.

Dr. J. C. Storey writes:

By the death of Keith Moore Whiting the profession has lost a gentleman and a doctor who lived for his patients. It was the writer's privilege to be in the same year as Keith Whiting during all the medical course, and, living in the same suburb, frequently to travel from Randwick to the school, and often on winter mornings to walk along Cleveland Street in his company.

Of commanding presence, he always was punctilious about his attire, without any evidence of personal conceit. He was "of" the university as well as "in" it. Whilst it could not be said that he was a brilliant examinee, he succeeded well enough to graduate in 1909, without having missed a year. He took an active part in the social and sporting activities of his time. A great oarsman, he won his seat in the eight. Well can be remembered his patient efforts to make a presentable "four" of some of the green hands in the year. He was a skilled amateur boxer, and reached the final of the middleweight championship of the university; also he played an excellent racket. Although no footballer, he willingly filled a gap in his year team, to make quite a good showing. Later in life he became a keen golfer and fisherman. His public spirit required him to serve in the militia, and he held commissioned rank in the old Sydney University Scouts.

Perhaps a trivial incident will illustrate his unselfish and sporting character. At one camp, in the writer's presence, he was officer of the day and had to attend the changing of the guard. It happened that on an unimportant point of guard drill he was wrong and the corporal of the guard right. Whiting ordered the corporal to alter the method. The non-commissioned officer obeyed with a reluctance that was just noticeable. As soon as the ceremony was over Whiting made inquiries and returned to the guard-room, freely to acknowledge the error and to congratulate the non-commissioned officer on obeying without opening his mouth.

In spite of family ties he went on active service with the Australian Imperial Force.

He was happiest when everyone around him was joyful. He married Miss Mary Smyth, the sister of his greatest friend, Dr. Jack Smyth, who also was in the same year. He was blessed by the happiest of homes. One of their children, Dr. T. K. S. Whiting, has joined the profession and gives promise of continuing the good example of his father.

Whiting settled in practice with his brother-in-law, Dr. R. A. Phipps Waugh, at Parramatta. Nothing but good has been heard of his work. He had a keen sense of humour and always saw the other fellow's point of view. In harness he has left us suddenly. No man can have spent a better or more useful life. May time and providence deal kindly with his dear ones.

Dr. Lindsay Dey writes:

It was with feelings of great regret that I heard of the passing of Keith Whiting so suddenly. That it occurred at his beloved holiday spot, Palm Beach, would, I am sure, be as he would have wished. That it happened in the prime of his life, when he meant so much to those round him, is another example of the toll that the life of service of a medical man exacts.

I first met Keith Whiting at the end of first-year medicine in Sydney University. In those days it was a big year; but he was soon known to all, and his geniality and good fellowship made him a friend of all in the year. He was keen on his work, and very thorough, and always exceedingly kind to the patients. In sport he was a keen tennis player, and, if my memory is correct, his interest in rowing was accounted for by his getting his "blue" in the university eight. That he went overseas and served in the Great War with distinction was what one would expect from him. After that he settled in Parramatta (New South Wales) with Dr. Dick Waugh, and was soon beloved and respected by the people there for the same qualities of thorough care and kindliness in his dealings with his patients. His loss will be keenly felt by all with whom he came in contact in his useful life.

JOHN PATRICK FARRELL.

We regret to announce the death of Dr. John Patrick Farrell, which occurred on January 24, 1939, at Cairns, Queensland.

WALTER HENRY TOFFT.

We regret to announce the death of Dr. Walter Henry Tofft, which occurred on January 29 at Campbell Town, Tasmania.

JAMES O'NEIL MAYNE.

We regret to announce the death of Dr. James O'Neil Mayne, which occurred on January 31, 1939, at Brisbane, Queensland.

NEVILLE ROY MARTIN.

We regret to announce the death of Dr. Neville Roy Martin, which occurred on February 4, 1939, at North Sydney, New South Wales.

JOHN CAPPIE SHAND.

We regret to announce the death of Dr. John Cappie Shand, senior, which occurred at North Sydney on February 5, 1939.

Correspondence.

LAY MEDICAL PRACTITIONERS.

Sir: Dr. Kevin Byrne's letter in the journal of January 21 is to be highly commended, and should be widely read among the medical profession. The recent Medical Practitioners Bill which was passed by the State Parliament is, at best, a miserable compromise with the quack evil which has been present with us for so many years and which has caused so much unnecessary suffering to many of the public. All of us who have been in practice for a number of years can recall painful cases which have not only been bled white of all their money by unscrupulous scoundrels of "lay practitioners", but have had taken away from them their one chance of recovery from some incurable disease. It seems incomprehensible that the ignorant and often impudent "lay practitioners" should be allowed to vaunt their so-called "cures" among the public, while the modern young medical man has had to spend the best years of his life in intensive study in order to earn a very modest income in his middle and old age. As Dr. Byrne points out, dentists, veterinary surgeons and even the humble plumber are not allowed to practise for gain without a licence. Why then should Christian Scientists, chiropractors, naturopaths and others like them be allowed to meddle with the valuable lives of men and women and, which is worse, of innocent children? Perhaps the State Minister for Health would answer this question.

Lately, a man in a country town, a "lay legal practitioner" this time, was imprudent enough to draw up a legal document and charge for it. It made one almost smile to see how quickly the Law Institute figuratively "jumped on him" and had him fined quite a substantial amount for daring to practise law without being qualified.

This incident is, of course, easily explained by the large number of legislators who belong to the noble profession of law. It is inconceivable that lay practitioners of law would ever be tolerated, and the laws as to the practice of that profession are, in consequence, commendably watertight.

Why the poor medical practitioner should be subjected not only to sneers and backbiting in the lay Press, but also have the opposition of various varieties of quacks passes the comprehension of many of us.

Yours, etc.,

Sydney, HERBERT THROSBY.
January 22, 1939.

SHORTAGE OF DOCTORS IN VICTORIA.

SIR: I have read with interest Sir James Barrett's letter in the journal of January 21, and I entirely agree with him that the report of the committee of the Victorian Branch of the British Medical Association on the shortage of doctors failed to emphasize the obligation of the medical profession towards the country people. It is, after all, the countryman who is not afraid of hardship and can live without cinemas and excitement who is most worthy of consideration.

I have practised in the "outback" of Canada and found it far more interesting than town practice, and I think the method of remuneration adopted by the municipality by which I was employed might be of interest to country districts in Australia.

The Lockerbie district in Alberta employed a doctor as health officer and general practitioner at a fixed salary. In order to protect the doctor from unnecessary calls a uniform charge was made for every visit, one dollar per visit to the doctor and three dollars per visit to the patient's house irrespective of the distance travelled, so that far country settlers had equal facilities with those nearer the town. These fees were collected by the municipality with the rates and were used to defray the doctor's salary. Mileage was paid by the municipality and private practice was allowed in surrounding districts. To perfect this scheme it is necessary that a bonus be paid to the doctor on the number of visits made. This protects the patient against slackness on the part of the doctor.

This very simple scheme has proved satisfactory to both doctor and patient for many years and does not burden the pioneer with heavy mileage fees which he is expected to pay in Australia.

Yours, etc.,

Traralgon, V. E. K. RULE.
Victoria,
January 22, 1939.

TRIGEMINAL NEURALGIA.

SIR: Though moved to sincere sympathy for Dr. Alec Lyons in his sufferings, solicitude for other sufferers from that frightful affliction *tic douloureux* makes it imperative that his advice "don't operate" should be unequivocally contradicted.

Essential to this challenge are the conditions, that firstly there shall be no doubt as to the diagnosis, and secondly that the surgical treatment shall be in the hands of one properly skilled and experienced in his work. I would not hesitate to state that failure to get complete relief is always due to incorrect diagnosis or unskilled surgery.

Any surgeon experienced in this work knows that there is in the whole realm of his practice no malady for which he can offer such complete and lasting relief as for true *tic douloureux*. This relief lies in properly skilled injections or section of the sensory root.

I know many contented and grateful people who would not be enthusiastic about Dr. Lyons's advice, and it is in the hope that others will not be rashly deprived of cure that I write this letter.

Yours, etc.,

Craigniah, I. DOUGLAS MILLER.
185, Macquarie Street,
Sydney.
January 20, 1939.

SIR: As one who suffered from trigeminal neuralgia of increasing severity until life became unbearable and was completely cured by operation nearly three years ago, I cannot allow Dr. Alec Lyons's letter of January 7, 1939, appearing in your paper of January 21, 1939, to go unchallenged.

In March, 1936, only chloroform anæsthesia relieved the severe paroxysms of pain. Against the advice of some of my medical *confrères* I decided to have an operation by a surgeon who I knew had performed the operation successfully on some ten patients with no deaths. The operation performed was partial division of the posterior root of the fifth nerve behind the ganglion, the eye fibres and motor roots being left intact. The operation was by the temporal route. The only inconvenience I have is hardly worth mentioning, namely, numbness of the lower part of the cheek and tongue.

In my opinion the success of the operation depends on accurate diagnosis, choice of operation, and last but of vital importance the skill of the operator.

I and many others have every reason to bless the surgeon who operated on us and trust that he may live long to give relief to our fellow sufferers.

Yours, etc.,

"Beanbah", CLARENCE READ.
235, Macquarie Street,
Sydney.
January 23, 1939.

NATIONAL HEALTH INSURANCE.

SIR: Dr. J. P. Major made a timely and very excellent appeal for unity in the profession and loyalty to elected leaders in his retiring address published in the journal of January 14, and with which we should all find ourselves in agreement; but he omitted two very important points, points which materially affect the issues raised.

On August 31, 1936, the Federal and State Governments were informed by letter of the general principles which, in the opinion of the Federal Council, should be the foundation of national health insurance; these principles had been accepted and adopted by the profession throughout Australia; they have never been rescinded. On the contrary, they were reaffirmed, and constituted the basis of direction when, at the August meeting of the Council, held at Adelaide in 1937, instruction was sought by our executive officers regarding the attitude to be taken by them in projected negotiations with representatives of the Government. The scheme ultimately adopted by the Government disregarded certain of these principles. Alteration or amendment of them—or indeed of any principle thus laid down—was dependent on the vote of the rank-and-file of the profession, not of the Council *per se*. Refusal to accept the proposed bill did not therefore constitute disloyalty to the Federal Council.

Secondly, it is to be regretted that Dr. Major failed to mention that a condition of acceptance of the agreement arrived at between the executive of the Council and the representatives of the Government—a condition enunciated by the President at the time—was its reference to the branches, presumably for ratification or rejection. This condition was ignored by the Minister who sought refuge in the charge of repudiation when later those most concerned with the implementation of the measure refused to ratify something that so flagrantly misinterpreted the Association's conception of a national health insurance scheme.

Having these circumstances in mind, one is unwilling to accept the rebuff administered by Mr. Casey and quoted by Dr. Major. May it not be that we erred only in our failure to rebut immediately in no uncertain terms the charge of repudiation made against us?

The future of the profession as a profession in Australia lies in efficient organization of our Association with an executive body possessing the confidence of its electors. Our experiences of the past year have surely taught us that without unanimity our opinions carry no weight where collective bargaining is the issue. Let us determine as a new year resolution that we will give our officers—State and Federal—the backing that alone can come from an interested and informed body of members prepared to present their opinions in open debate to the end that their chosen representatives may confidently express the will of their electors before a council whose powers under the constitution are admitted and accepted.

Yours, etc.,

F. W. CARTER,
Member of the Federal Council for Western Australia; member of the Council of the Western Australian Branch.

360, St. George's Terrace,
Perth,
January 23, 1939.

SIR: Dr. Sydney Pern's letter in your issue of January 14 (*re* national health insurance) expresses succinctly, and in dispassionate sincerity and truth, the exact position in London (I can only speak for London) as regards the medical profession; and in a few terse sentences reveals the state to which the general practitioner has been brought as a result of the operation of national health insurance.

As one who has experienced the ennobling effects of a panel practice in London, I am game to bet a yen that there is no civilized country in the world where the social status of the doctor is so low.

As I have written at length in vigorous protest against this state of affairs both in *The British Medical Journal* and in THE MEDICAL JOURNAL OF AUSTRALIA, I shall not labour the point but conclude with Dr. Sydney Pern's admonition: "It would be an appalling thing if the medical profession was reduced to the same state of servitude as exists at the present time in England." It would be as bad as debasing the currency.

Yours, etc.,

F. S. TAYLOR THOMAS.

209, Coogee Bay Road,
Coogee,
New South Wales.
January 27, 1939.

Medical Practice.

TRANSPORTATION OF PATIENTS IN AEROPLANES.

THE following letter is published at the request of the Secretary of the Victorian Branch of the British Medical Association:

The Secretary,
British Medical Association,
426, Albert Street,
East Melbourne, C.2.

Dear Sir:

As you are probably aware, we and other airline operators throughout Australia have frequently carried sick passengers as stretcher cases in our regular service aeroplanes and our policy is to do this, subject to the production of a certificate from the patient's medical adviser that the patient is in a fit condition to travel by air and that he is not suffering from any infectious disease.

Recently we had a case of this nature when the patient was conveyed from Melbourne to Sydney. The patient came straight out of hospital and was conveyed to Essendon by ambulance and the trip by air to Sydney was carried out as arranged, but under very difficult circumstances so far as the patient himself, his attendant and the air hostess were concerned, owing to the absence of a bed pan or any other facility for attending to the passenger's comfort.

It is our desire to continue to provide facilities for the conveyance of such passengers by our regular services rather than put them to the expense of chartering special machines, and we feel that your Association could assist us by arranging to have your members circularized through the medium of your journal or journals throughout Australia, pointing out that when such passages are arranged, the medical attendant should see that any necessary equipment is provided.

Thanking you in anticipation of your assistance,

We are,
Yours faithfully,
(Signed) H. R. MATTHEWS,
Manager, Australian National Airways, Proprietary, Limited.

Bulla Road,
Essendon, W.6,
Victoria.
January 19, 1939.

The Royal Australasian College of Physicians.

EXAMINATION FOR MEMBERSHIP.

THE Honorary Secretary of the Royal Australasian College of Physicians has informed us that the notice concerning the examination for membership of the College, forwarded by him and published in the issue of January 28, was incorrect. The following is the correct notice:

The written examination for Membership of the Royal Australasian College of Physicians will be held in the capital cities of Australia where candidates are offering on Saturday, February 25, 1939. The clinical examination will be held in Melbourne on March 21 and 22, 1939.

Analytical Department.

"OLIO SASSO."

"OLIO SASSO" is a brand of olive oil manufactured in Italy and imported by B. Callose and Sons Proprietary Limited, of 22 Campbell Street, Sydney. A sample was submitted to our analyst, who reports as follows:

We have examined the sample of "Olio Sasso" olive oil submitted by you and found as follows:

	Sample.	Required by British Pharmacopœia (1932).
Specific gravity at 15·5° C.	0·917	0·915-0·918
Refractive index at 40° C.	1·4620	1·4605-1·4635
Acid value	0·69	Not more than 2·0
Saponification value	190·0	190-195
Iodine value	83·6	79-88

The sample complies with the tests for the absence of cottonseed oil, of sesame oil, and of arachis oil.

On this evidence "Olio Sasso" can be recommended with confidence wherever the prescription of olive oil is deemed advisable.

Proceedings of the Australian Medical Boards.

SOUTH AUSTRALIA.

THE undermentioned have been registered, pursuant to the provisions of the *Medical Practitioners Act*, 1919, of South Australia, as duly qualified medical practitioners:

Yeatman, John Charleton, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Gild, David, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Shortridge, Dennis Thorman, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Campbell, Allan Gordon, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Magarey, James Rupert, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Elix, Robert Hugo, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
Cherry, Edward Percival, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.
De Vedas, Jack, M.B., B.S., 1938 (Univ. Adelaide), Adelaide.

Books Received.

MEDICAL RESEARCH COUNCIL OF THE PRIVY COUNCIL. SPECIAL REPORT SERIES NUMBER 232: THE MEDICAL USES OF RADIUM—SUMMARY OF REPORTS FROM RESEARCH CENTRES FOR 1937; 1938. London: His Majesty's Stationery Office. Royal 8vo, pp. 48, with illustrations. Price: 1s. net; postage extra.

Diary for the Month.

FEB. 14.—New South Wales Branch, B.M.A.: Executive and Finance Committee.
FEB. 21.—New South Wales Branch, B.M.A.: Ethics Committee.
FEB. 22.—Victorian Branch, B.M.A.: Council.
FEB. 23.—South Australian Branch, B.M.A.: Branch.
FEB. 24.—Queensland Branch, B.M.A.: Council.
FEB. 28.—New South Wales Branch, B.M.A.: Medical Politics Committee.
MAR. 1.—Western Australian Branch, B.M.A.: Council.
MAR. 1.—Victorian Branch, B.M.A.: Branch.
MAR. 2.—South Australian Branch, B.M.A.: Council.
MAR. 7.—New South Wales Branch, B.M.A.: Organization and Science Committee.
MAR. 10.—Queensland Branch, B.M.A.: Council.
MAR. 13.—Federal Council of B.M.A. in Australia (Melbourne).
MAR. 14.—New South Wales Branch, B.M.A.: Executive and Finance Committee.
MAR. 14.—New South Wales Branch, B.M.A.: Ethics Committee.
MAR. 21.—New South Wales Branch, B.M.A.: Medical Politics Committee.
MAR. 22.—Victorian Branch, B.M.A.: Council.
MAR. 24.—Queensland Branch, B.M.A.: Council.
MAR. 28.—New South Wales Branch, B.M.A.: Council (Quarterly).
MAR. 30.—South Australian Branch, B.M.A.: Branch.
MAR. 30.—New South Wales Branch, B.M.A.: Annual Meeting.

Medical Appointments Vacant, etc.

For announcements of medical appointments vacant, assistants, *locum tenentes* sought, etc., see "Advertiser", pages xviii to xx.

CHILDREN'S HOSPITAL, CARLTON, VICTORIA: Physiotherapist.
PUBLIC SERVICE OF SOUTH AUSTRALIA: Medical Officers.
RENWICK HOSPITAL FOR INFANTS, SUMMER HILL, NEW SOUTH WALES: Honorary Physician.
ROYAL HOSPITAL FOR WOMEN, PADDINGTON, NEW SOUTH WALES: Honorary Surgeon.
THE BENEVOLENT SOCIETY OF NEW SOUTH WALES: Honorary Officers.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment referred to in the following table without having first communicated with the Honorary Secretary of the Branch named in the first column, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

BRANCHES.	APPOINTMENTS.
NEW SOUTH WALES: Honorary Secretary, 135, Macquarie Street, Sydney.	Australian Natives' Association. Ashfield and District United Friendly Societies' Dispensary. Balmain United Friendly Societies' Dispensary. Leichhardt and Petersham United Friendly Societies' Dispensary. Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney. North Sydney Friendly Societies' Dispensary Limited. People's Prudential Assurance Company Limited. Phœnix Mutual Provident Society.
VICTORIAN: Honorary Secretary, Medical Society Hall, East Melbourne.	All Institutes or Medical Dispensaries. Australian Prudential Association, Proprietary, Limited. Mutual National Provident Club. National Provident Association. Hospital or other appointments outside Victoria.
QUEENSLAND: Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17.	Brisbane Associate Friendly Societies' Medical Institute. Proserpine District Hospital. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.
SOUTH AUSTRALIAN: Secretary, 178, North Terrace, Adelaide.	All Lodge appointments in South Australia. All Contract Practice Appointments in South Australia.
WESTERN AUSTRALIAN: Honorary Secretary, 205, Saint George's Terrace, Perth.	All Contract Practice Appointments in Western Australia.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Orginal articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

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